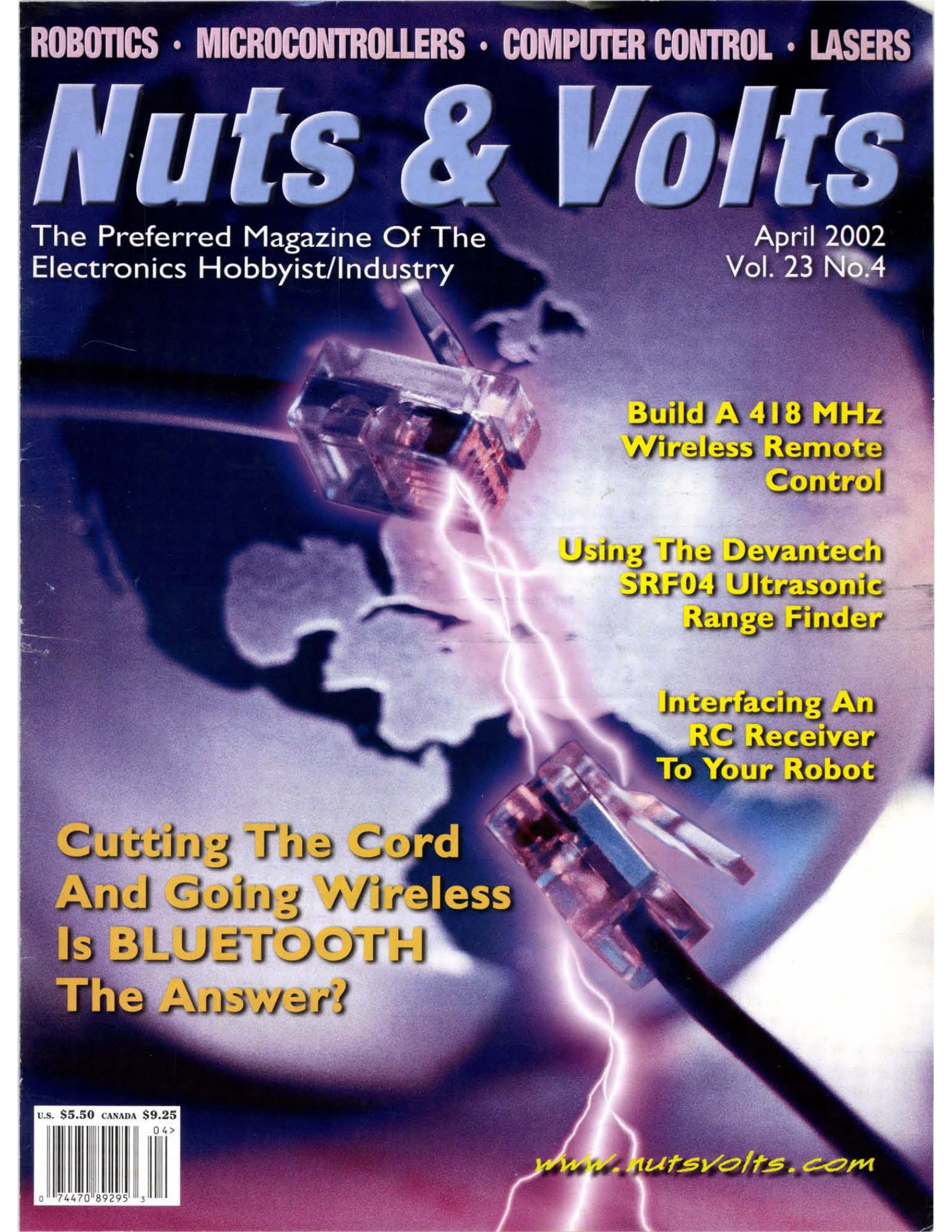
ROBOTICS · MICROCONTROLLERS · COMPUTER CONTROL · LASERS

Nuts & Volts

The Preferred Magazine Of The
Electronics Hobbyist/Industry

April 2002
Vol. 23 No.4



Build A 418 MHz Wireless Remote Control

Using The Devantech SRF04 Ultrasonic Range Finder

Interfacing An RC Receiver To Your Robot

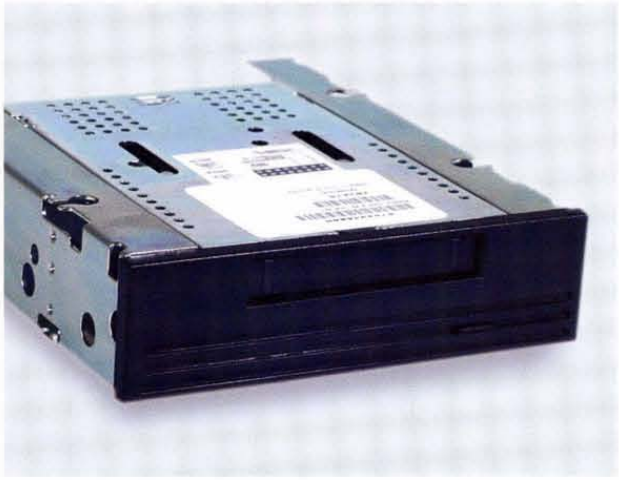
Cutting The Cord And Going Wireless Is BLUETOOTH The Answer?

U.S. $5.50 CANADA $9.25
04>
0 74470 89295 3

www.nutsvolts.com

AUCTION BLOWOUT!

Over 2,000 Items on Ebay! Many from Distressed or Bankrupt Dot-Coms!



24GB Ultra SCSI DAT Tape Drives
No Minimum Bids!

Cisco Routers and Hubs
Bids Start at $50

Sun Workstations and File Servers
No Minimum Bids!

15,000 RPM Ultra 160 Hard Drives
$10 Minimum Bid

Disk drives cost too much. Take advantage of dot-com closeouts and bankruptcies. We're liquidating thousands of PCs, hard drives, and accessories. Visit www.scsidrives.com and name your own price! Join our mailing list for advance notice when special sale items arrive!

CORPORATE SYSTEMS CENTER
3310 Woodward Avenue, Santa Clara, CA 95054 (408) 588-1110

Circle #81 on the Reader Service Card.

Cat5 Patch Cable

Just under $.50 each by the case!!

- 'Foxconn' #CT88B12T88-A17, Yellow, 12 ft.
- New, sold by case only (80 cables/case)

HSC#19234 $39.95

Disk Drive Deals!

4.0GB IDE Laptop
- Fujitsu MMC2040AT, 33.3MB/s(UDMA)
- **HSC#18134 ATA-3 to standard IDE connector adapter available.**
- OEM pkg, 90-day warranty

HSC# 19256 $55.00

4.3 GB SCSI 1/2 HEIGHT
- ST15150N hard drive
- 21 Hds, 11 Disks, 3,711 Cyl.
- 7,200 RPM, 9.0 mS avg. seek
- HSC 90-day warranty

HSC# 18412 $24.95

9.1GB SCSI
- Seagate ST19171
- 7200RPM, 4.6mS av. latency
- 50-pin connector
- HSC 90-day warranty

HSC# 19247 $39.95

Pentium II Special!

- Dell 'GX1', P-2/350 MHz
- 6GB HD, 32X CD, 3.5" FD
- 64MB RAM (128MB - add $10)
- Video, sound, USB, Netwk, SIO/PIO
- Keyboard & mouse included! Limited quantities!

HSC# 19251 $249.00!

System Special!

- AT-style motherboard, Pentium 90
- 850MB HD, 32MB RAM, Floppy, Network card, PCI video, SIO,PIO
- 5 ISA, 3 PCI slots
- Keyboard & mouse included!
- Used, tested, 30-day warranty

HSC# 19231 $49.95

Pentium M/B

- Asus Model No. P599VM
- For Intel P55C-MMX/P54C/P54CS AMD K6-2/K6-III, IBM/Cyrix MII
- 3-DIMM,3-PCI,1-ISA,SIO/PIO/USB
- 8MB AGP, 2MB Flash, 1MB cache
- Much more!! 90-day warranty

HSC#19237 $39.50

HSC Special Package Deal!

BUY THE ABOVE MOTHERBOARD & ADD A AMD K6-2/450 MHz CPU FOR JUST..... $59.50!!

-OR-

ADD A AMD K6-2/333 MHz CPU FOR ONLY..... $49.50!!

HSC Web Specials!

You can find these in the "Specials" area of our on-line shopping pages at *www.halted.com*...check them out and use our secure site to place your order.

20KOhm/V Analog VOM
HSC# 18260 $9.95

150W MicroATX Pwr. Supply
HSC# 19239 $19.95

10-Base T card, ISA
HSC# 18943 $4.95

Mouse, w/ keypad
HSC# 80539 $4.95

Initio SCSI Cntlr, PCI
HSC# 18218 $9.95

Tower, cabinet, 7-bay
HSC# 80544 $42.50

Adaptec SCSI, ISA
HSC# 17995 $7.50

Color camera, digital
HSC# 17503a $9.95

Motherboard, 486DX4 AT
HSC# 18529 $9.95

Batt charger, NiMH
HSC# 19151 $17.50

Memo Recorder w/VOX
HSC# 80618 $14.95

A/V 'Firewire' card,
HSC# 80613 $45.00

6VDC, 12Ah lead-acid
HSC# 19283 $9.95

SCSI scanner cntlr.
HSC# 19221 $4.95

12VDC 40 AH, lead/acid
HSC# 18917 $29.50

Pixie2 Tranciever Kit
HSC# pixie $9.95

Advanced Clamp Meter
HSC# 80609 $110.00

Basic Clamp Meter
HSC# 80608 $45.00

Joystick, "FX2000"
HSC# 18772 $3.00

ATX, 145W Power Supply
HSC# 18350 $9.95

Bargain DMM
HSC# 80370 $14.95

Mouse, 2-button
HSC# 18731 $3.95

Server Cabinet, ATX
HSC# 80541 $149.95

ATX 200W Power Supply
HSC# 18665 $14.95

Power Supply Deals!

- Cherokee Model No. MQT154A1 - 150W
- 100-240VAC, 47-63Hz, 3A
- +5VDC@26A, +3.3VDC@8A, +12VDC@6A, -12VDC@1A
- New, OEM packed, 90-day warranty

HSC# 19266 $17.50

- Cherokee Model No. MQT154A1 - 200W
- 100-240VAC, 47-63Hz, 3A
- +5VDC@26A, +3.3VDC@8A, +12VDC@6A, -12VDC@1A
- New, OEM packed, 90-day warranty

HSC# 19267 $19.95

SuperStack II Switch

- 3Com SuperStack II Switch 1000 10BaseT hub
- I2 MDIX ports, full duplex support, Virtual LAN
- Multi-forwarding, advanced security, much more!
- New, factory-boxed units - 90-day warranty

HSC# 19284 $35.00!

2mW Slim Laser!

- 2mW HeNe red laser, <.75" dia!
- Compact power supply included!
- 12VDC@700-800mA
- Intended for M16 rifle sight spot
- Limited quantities...
- OEM packed, 30-day warranty

HSC#19278 $39.50

600W Solder Pot

- Model AEEC-60P
- 110VAC, 60Hz
- 300 deg. C & 500 deg. C
- 100mm. W x 45mm. D
- New...90-day warranty

HSC# 80611 $97.50

Table Top Solder Pot

- Model AEEC -10P
- Handy compact unit
- Bath: 36mm. dia x 30mm. deep
- 300 to 430 deg. C
- New...90-day warranty

HSC# 80610 $32.00

PCMCIA SCSI!

- EPSON PCMCIA interface card
- Epson/Adaptec APA-460B
- Up to 2mB/sec. bus rate
- For DOS, Win3.1, 95/98 & NT
- OEM pack, w/DB-25 cable
- 90-day warranty

HSC# 19160 $49.50

56K Modem/Hub

- Four-port hub card, with 56K V90 modem
- For multi-PC web access!
- ISA-type, OEM package
- 90-day warranty

HSC# 18942 $17.50

Video Players!

Dual Power Built-In!
- Model No. VHS-10S player deck pulls
- Std NTSC VHS format, frnt-pnl controls
- Perfect for on the road!
- HSC 90-day warranty

HSC# 19048 $19.95

115VAC Unit
- Magnavox video player, working pulls
- Standard 'F' & RCA connectors
- Switch selected Ch. 3 or Ch. 4 output
- HSC 90-day warranty

HSC# 19152 $17.50

12VDC Unit
- Same as #19152, but 12VDC
- Full front panel controls
- Remote capable - remote not incl.
- HSC 90-day warranty

HSC# 19223 $17.50

PCMCIA Ethernet!

- EPSON Type II PCMCIA interface card
- 10Base2 &10BaseT cables included!
- For notebooks/PCs with Type II slots
- For Windows 3.1, 95/98
- No jumpers or switches - Two LED status lights
- New, boxed, diskette & manual, 90-day warranty

HSC# 19125 $9.95

HSC Electronic Supply

Since 1963!...

Silicon Valley's Electronic Marketplace

3 Retail/Wholesale Locations:
Main Office - Mail Orders...
3500 Ryder St. Santa Clara, CA 95051

Santa Clara	1-408-732-1573
Sacramento	1-916-338-2545
Rohnert Park	1-707-585-7344

Order Toll-Free:
1-800-4-HALTED (442-5833)
or...ONLINE, AT: *www.halted.com*

Terms: Some quantities limited; all items are subject to prior sale. **Minimum order: $10.00 plus shipping.** Orders under $20.00 subject to $2.00 handling fee, in addition to shipping. All orders shipped by UPS Surface unless otherwise specified. $6.00 UPS charge added for COD. Visit our website for detailed information on domestic and international shipping methods.

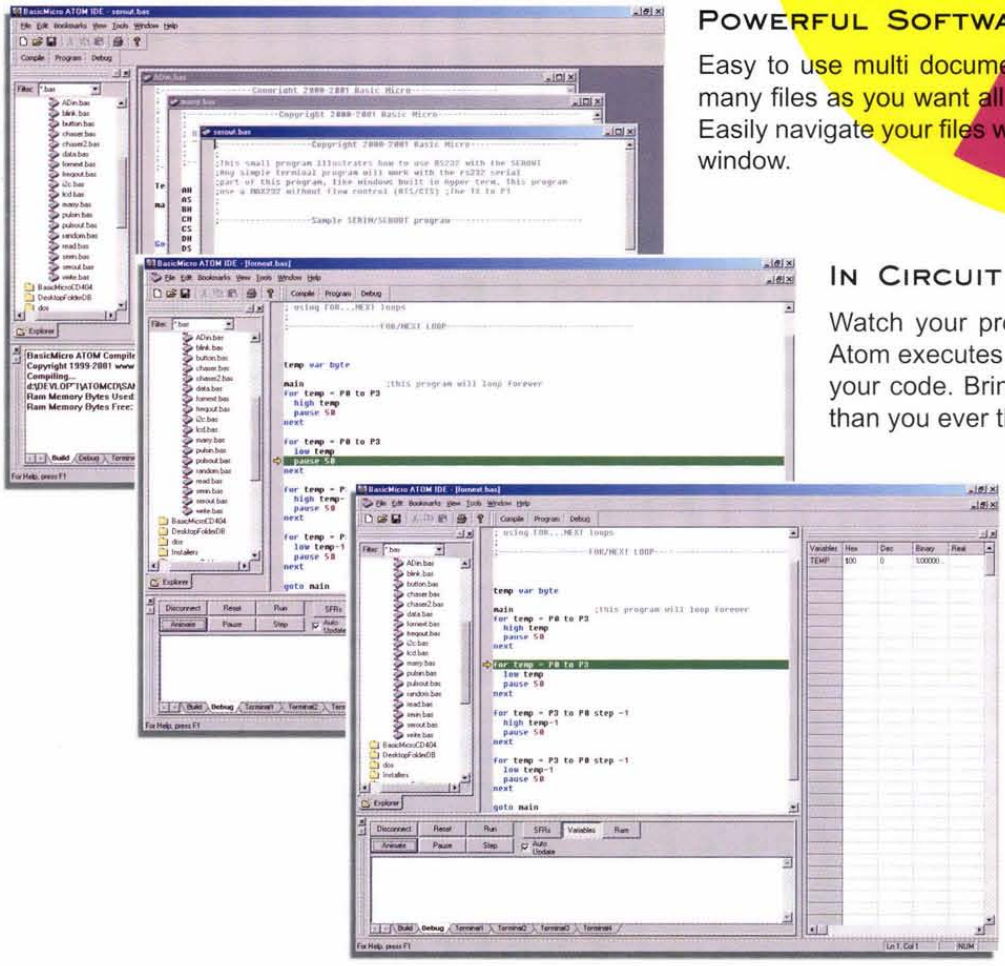
Circle #53 on the Reader Service Card.

More Power...

The New Basic Micro Atom, offers more in the same package you are already familiar with. Built-in features like upgradeable firmware, Analog to Digital, Hardware Serial, In Circuit Debugging, 32 Bit Math, 32 Bit Floating Point Math and more !

The Atom includes powerful expanded BS2 syntax compatible software with commands such as; OWout, OWin, ADin, LCDwrite, If..Then..Elseif..Else..Endif, LCDread, HPWM, Hserout, Hserin, Do..While, Repeat..Until and more !

Atom-IC Module
Only $59.95



Powerful Software

Easy to use multi document interface. Open as many files as you want all in the same interface. Easily navigate your files with the built-in explorer window.

In Circuit Debugging

Watch your program run step-by-step as the Atom executes each line of code. Easily debug your code. Bring your programs to life quicker than you ever thought possible !

Watch it Come to Life

No more strategically placing debug statements throughout your program! Not only can you watch your program execute live, you can keep an eye on every variable and ram location as they are affected by your program. Each program variable is displayed in binary, hexadecimal and its real values.

Features

- Graphical Debugging (ICD)
- More Software Commands
- 32 Bit Integer Math
- 32 Bit Floating Point Math
- BS2p Compatible Syntax
- Expanded BASIC library
- Firmware upgradeable
- Unlimited Support
- Free Software Updates
- Plus More!
- Over 300 Bytes of RAM
- 256 Bytes of Data EEPROM
- External & Internal Interrupts
- 3 10 bit A/D Converters
- 2 Capture and Compare
- Internal Adjustable Vref
- + / - External Vref
- 3 Timers, 2 PWM
- UARTS, I2C, SPI
- Plus More!

Development Kits

Kit Includes: Development Board, Atom, Manual, Cable and power supply

Only $149.95

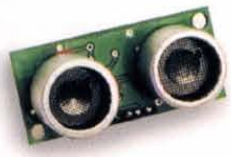
BASIC MICRO INC
Microcontrollers Made Easy™

To order visit **www.basicmicro.com** or call us at 734-425-1744 M-F 10 AM to 6 PM

The Basic Atom is a registered trademark of Basic Micro Inc.

Nuts & Volts

VOLUME 23 • NO. 4 • APRIL 2002



10 DEVANTECH SRF04 ULTRASONIC RANGE FINDER
Devantech has designed a nice detector package with the SRF04 that can be purchased for around $25.00. **By Kerry Barlow**

20 HANDHELD RADIO WITH BUILT-IN GPS
The long overdue handheld two-way radio with built-in GPS and maps is here! **By Gordon West**

44 LEARNING RVK-BASIC — PART 4
Explore the use of the A/D converter and the UART. **By Bob Vun Kannon**

48 THE BLINKERY BLINKEROO FLASHING LIGHT
This is a perfect beginner's gadget for someone who has never built an electronic project before. **By George, Rachel, and Thomas Philips**

59 DUSTMEISTER — PART 2
Hunting the Elusive Dust Bunny." Build a tool sensor from scratch, and program and test the DUSTMEISTER. **By Robert Lang and Thomas Ober**

67 BUILD A 418 MHz WIRELESS REMOTE CONTROL
This is an easy-to-build remote control system that can be used in many applications. **By Anthony J. Caristi**

73 INTERFACING AN RC RECEIVER
Learn how to connect RC gear to your bot. **By Michael Simpson**

COLUMNS

TECHKNOWLEDGEY 2002 6
Robots assist in search-and-rescue operations; Mars orbital camera returns more images; IBM offers cheaper mainframes; 3-D imaging on your computer; New type of consumable memory unveiled; Computer crime doesn't pay (if you get caught); Cornell sues Hewlett-Packard; and AOL subscribers sue AOL. **By Jeff Eckert**

ELECTRONICS Q & A 22
What's Up: LVDTs explained ... you might be surprised. Lots of counter circuits for lotsa applications. Cheap data logger and a simple time delay relay. Finally, is there really such a thing as an electronic fuse? You decide. **By TJ Byers**

STAMP APPLICATIONS 35
Sonic Sight-seeing with Sound. Using the Devantech SRF04 ultrasonic range finder. **By Jon Williams**

NEW COLUMN!!
OPEN COMMUNICATION 38
This every-other-month column will cover various aspects of electronic communications and networking. This month, Bluetooth wireless technology is covered. **By Louis E. Frenzel**

LASER INSIGHT 64
Putting together a simple pulsed gas laser from parts you have in your garage. **By Stanley York**

AMATEUR ROBOTICS 77
Meet Chug — a robot vacuum cleaner. **By Robert Nansel**

DEPARTMENTS

Reader Feedback	13
Tech Forum	16
New Books	26
News Bytes	28
Dealer Directory	30
Events Calendar	32
Electronics Showcase	42
Prize Drawing	45
New Product News	50
Classified Ads	51
Classified Ad Info	55
Advertiser's Index	72
NV Bookstore	83

Nuts & Volts (ISSN 1528-9885) is published monthly for $24.95 per year by T & L Publications, Inc., 430 Princeland Court, Corona, CA 92879. PERIODICALS POSTAGE PAID AT CORONA, CA AND AT ADDITIONAL MAILING OFFICES. POSTMASTER: Send address changes to Nuts & Volts, 430 Princeland Court, Corona, CA 92879-1300.

Events, Advances, and News From the Electronics World

by Jeff Eckert

TechKnowledgy 2002

Advanced Technologies

Robots Assist in Search-and-Rescue Operations

For obvious reasons, most press coverage of the World Trade Center atrocity has focused on the human element. However, the events of September 11 also catalyzed what appears to be the first use of robots for rescue and reconnaissance operations in an urban disaster area. Within six hours of the event, the Center for Robot-Assisted Search and Rescue (CRASAR) had responded with a cache of robots, sending teams from Foster-Miller, Inc. **(www.foster-miller.com)**, iRobot Corp. **(www.irobot.com)**, the University of South Florida **(www.usf.edu)**, and the Space and Naval Warfare Systems Command (SPAWAR, **enterprise.spawar.navy.mil/spawarpublicsite/**).

The robots were dispatched to perform two functions: to search for survivors and to survey structures at "Ground Zero" to determine whether it was safe for humans to enter. Unfortunately, no survivors were found, but the robot team generated sensory information that was useful in the search and clean-up. This is widely viewed as simply the first step in the development and implementation of such devices.

CRASAR is a nonprofit rise response and research organization that is seeking to exploit robots and other unmanned devices for humanitarian purposes worldwide. It operates under the auspices of the National Institute for Urban Search and Rescue. For more images and information about CRASAR, visit **www.csee.usf.edu/robotics/crasar/pics/reconrobots/**.

"iRobot's Packbot performs reconnaissance of WTC surrounding structures."
Courtesy of the Center for Robot-Assisted Search and Rescue.

"A small army of robots awaits deployment at Ground Zero."
Courtesy of the Center for Robot-Assisted Search and Rescue.

"A robot's-eye view of human relief workers at Ground Zero, transmitted by a Talon robot provided by Foster-Miller."

"Eerie nighttime scene of the rubble at Tower Two location."
Courtesy of the Center for Robot-Assisted Search and Rescue.

Mars Orbital Camera Returns More Images

Meanwhile, circling a far more placid planet, the Mars Global Surveyor recently began its second year of extended mission operations by providing some unexpected information. In 1999, the Mars Orbital Camera (MOC) detected an array of odd layers, scarps (cliffs caused by erosion), and "swiss cheese" holes in the south polar cap. Later images of the same areas revealed that the polar scarps had retreated approximately 3 m in less than one Mars year (687 Earth days). Early this year, scientists concluded that such rapid changes could have occurred only if the south polar cap is composed primarily of frozen carbon dioxide ("dry ice") rather than water ice. The two photos, illuminated from the upper left by sunlight, each cover an area 2 km wide by 6.9 km long. The arrows point at the same location, showing a drift in the topography. And because the polar cap is shrinking, it is now believed that the climate of Mars is undergoing a major change, perhaps coming out of an ice age. At the present rate of carbon dioxide release into the Mars atmosphere, there could be a fairly thick cover of "greenhouse gases" within a few hundred to a thousand years. This, in turn, could cause a global warming that thaws liquid water, encourages plant growth, and so on. At that point, it will be only a matter of months before the first McDonald's appears. For details, visit the Malin Space Science Systems web site **(www.msss.com/mars_images/moc/1yearExtend/)**. The MOC, incidentally, was built by Malin and the California Institute of Technology using spare hardware from the Mars Observer mission.

"Recently detected drifts in the Martian south polar regions have led scientists to the conclusion that the polar cap is made of frozen carbon dioxide. Photo courtesy of NASA/JPL/Malin Space Science Systems.

Computers and Networking

IBM Offers Cheaper Mainframes

In February, IBM **(www.ibm.com)** announced a new e-business oriented mainframe computer geared toward the more cost-conscious consumer. While most IBM mainframes cost $1 million plus, the new z800 server will dent you for only about $375,000.00. All z800 boxes are powered by a five-processor multichip module. The first processor unit (PU) is

generally designated a general-purpose engine. PUs two through four can be defined as general-purpose, integrated facility for Linux, or coupling facility engines for use in a parallel Sysplex cluster. The final PU is used as a System Assist Processor to drive large amounts of data through the I/O subsystem. All models incorporated a total of 16 optional PCI Cryptographic Coprocessors and/or PCI Cryptographic Accelerators that support thousands of Secure Sockets Layer (SSL) transactions per second, thereby providing FIPS 140-1 level 4 security. All have 8 to 32 GB of main memory, a 64-bit architecture.

3-D Imaging on Your Computer

A new gadget from TDV Technologies **(www.tdv3d.com)** promises to bring three-dimensional viewing to your PC. The company's TDV 3D product — devised primarily for users of computer games — consists of a bundle of software and a pair of viewing glasses. The software converts 2-D applications into 3-D ones, and it is compatible with most industry standard 3-D graphics accelerators. Basically, TDV 3D works with your monitor by alternating each liquid crystal lens between opaque and transparent, and at the same time, flashing slightly different images on the monitor so that each eye sees a different version of the image. In this manner, the illusion of three dimensions is created.

If you aren't a game player, never fear. According to the company, the device can also be used for online shopping, education, fashion and lingerie shows, Sony IMAX movies, and, perhaps best of all, the latest *Sports Illustrated* swimsuit calendar. And it's all yours for only $99.95 online. But note: it cannot be used with flat-screen or laptop computer monitors.

Circuits and Devices

New Type of Consumable Memory Unveiled

In a conventional memory chip, the semiconductor fabrication process puts a single layer of devices on the active top portion of a substrate. Thus, when you want more devices on a chip, the chip spreads out horizontally. But a new process introduced by Matrix Semiconductor, Inc. **(www.matrixsemi.com)**, uses a modified 0.25 micron CMOS process to stack memory devices vertically, thereby creating up to 10 times the number of chips on the same size wafer. Matrix claims to be the first company to successfully develop a technology for producing such devices in high volumes, at low costs, and using standard materials and processes.

The first product, due out later this year, will be the Matrix 3-D Memory, a "write-once" 64-MB storage chip developed as a "consumable" product that can be used in much the same way as traditional camera film or audio tape. The market is envisioned to include digital cameras, digital audio players, portable games, cell phones, and so on. Although no specific information on price is available, it is expected that the devices will be much cheaper than today's flash memory. The company is backed by $80 million in venture capital, and investors are rumored to include Microsoft, Kodak, Sony, and others.

Industry and the Profession

Computer Crime Doesn't Pay (If You Get Caught)

Computer systems administrator Tim Lloyd was recently convicted of planting a software "time bomb" in a file server at Omega Engineering, his former employer. The bomb destroyed the company's production machinery software, which cost Omega more than $10 million in direct losses and $2 million in reprogramming. This led to layoffs of 80 employees. Lloyd will serve 41 months in a federal penitentiary and has been ordered to pay more than $2 million to Omega in restitution. The case has been hailed as a landmark, proving that the federal government is capable of tracking down and punishing computer criminals. However, it is estimated that only about two percent of all software attacks are ever reported to the authorities.

In an unrelated case, the co-leader of a software piracy group, known as DrinkOrDie, has pleaded guilty to federal conspiracy charges. John Sankus, Jr., faces up to five years in prison and a $250,000.00 fine for his crimes. DrinkOrDie was involved in illegal online distribution of pirated copies of computer games and videos and other software. Sankus apparently directed about 60 people who acquired the titles, stripped away security features, and generated counterfeit copies. DrinkOrDie then sold the illegal copies on a worldwide basis. It has been reported that the US Department of Justice's computer crime and intellectual property section is cooperating with the US Attorney's office in a long-term effort to prosecute hundreds of suspected software pirates.

Cornell Sues Hewlett-Packard

Cornell University officials recently announced that the university and the Cornell Research Foundation have filed suit in the US District Court, asserting that the Hewlett-Packard Company is infringing on a patent issued in 1989 that covers a computer instruction processing technique created by Professor Emeritus H.C. Torng of Cornell's School of Electrical and Computer Engineering. The invention (US patent No. 4,807,115) accelerates a computer's processing speed. The patented technique is applicable to computer processors with multiple functional units, and it permits multiple instructions to be issued per machine cycle, out of program order, thereby increasing processing efficiency and speed.

Cornell's suit alleges that Hewlett-Packard has been infringing on the patent since 1995. According to James J. Mingle, university counsel and secretary of the corporation, the patent infringement could lead to a request for damages in excess of $100 million, and the university intends to pursue the litigation vigorously. Mingle indicated that Cornell's numerous efforts to

SolderingDesoldering.Com
Your SMD Rework Specialist
800-394-1984

Circle #69 on the Reader Service Card.

address the infringement have been repeatedly rebuffed by Hewlett-Packard.

And AOL Subscribers Sue AOL

America Online **(AOL, www.aol.com)** is not exactly known for being a soft-sell kind of company. For example, they routinely offer trial memberships consisting of 1,000 hours of free access. Unfortunately, you have to use all 1,000 hours within a 45-day period, and there are only 1,080 hours in 45 days. This is great if you don't need more than 1.8 hours of sleep per night, would like to spend every minute of your life logged onto AOL, and have no bodily functions that require you to leave your terminal.

And whenever AOL subscribers log on, they are pummeled with pop-up windows that try to sell them a range of products. To avoid ordering these items, they must click on a "No Thanks" button. AOL has credit card and/or bank account information on all of subscribers, and it charges user accounts directly for items purchased.

Now, three Californians have filed suit in federal court in San Francisco alleging that, even though they declined the sales pitches, AOL nevertheless sent them merchandise that includes a desk planner ($10.00), a CD player ($171.00), and a "bed in a bag" ($74.00). Only three users are part of the suit as of this writing, but Barry Himmelstein, an attorney for the plaintiffs, says that more than 200 individuals have already contacted him and reported the same problem. Himmelstein is therefore seeking class-action status for the suit, which could become a serious problem for AOL if more than a few of its 33 million subscribers have experienced this problem. The suit is being handled by Lieff Cabraser Heimann & Bernstein, LLP. If you have received unordered merchandise from AOL or CompuServe, you might want to visit **www.lieffcabraser.com/aol_contact.htm**. The aggressive sales tactics are unlikely to stop, given that AOL Time Warner lost $1.8 billion in the fourth quarter of 2001, in spite of having revenues of $10.6 billion. The company also faces class-action suits from subscribers who were connected by AOL software via long distance lines and unexpectedly incurred monthly charges that in some cases exceeded $1,000.00. **NV**

Earn Your Degree at Home!

Cleveland Institute of Electronics offers comprehensive yet affordable independent study training programs in electronics and computer technology. Experience a step-by-step teaching method designed specifically for the independent study student.

Build on what you already know!

You may be eligible to apply for advanced standing in CIE's A.A.S. Degree Program based on your previous work life experience, military training or academic history. If you're like most readers of this magazine, your electronics background can help you receive your degree in less time than you think!

Choose from many programs!

Earn an Associate in Applied Science in Electronics Engineering Technology or a Diploma from one of our other high tech programs. All the lab equipment and instructor support you need to succeed is included with every program.

Name _____
Address _____
City _____
State _____ Zip _____
Phone _____ ANV03
Send for a **FREE Course Catalog**
CIE: 1776 E. 17th, Cleveland, OH 44114

Call **(800) 243-6446** or visit **www.cie-wc.edu** for a **FREE Catalog!**

FCC Course *with* Certificate

A Powerful 19 Lesson Self-Study Program on one CD!

new

After completing this course you will be ready to take the FCC examination for a General Radiotelephone Operator License.

The General Radiotelephone Operator License is required to adjust, maintain or repair any FCC licensed radiotelephone transmitters in the aviation, maritime and international fixed public radio services. It is issued for the lifetime of the holder.

Course: 01-FCC02

19 FCC Lessons on CD ROM

Every lesson is presented in a clear and easy-to-understand format which makes learning this material fun and easy. After each lesson you'll take an exam. You can take it on-line or fill out one of the answer sheets we provide and mail it. After you finish the 19 lessons we'll send you a Certificate of Completion from Cleveland Institute of Electronics that's suitable for framing.

CIE Instructor Assistance with Priority Grading

Use our toll-free hot line to talk with our faculty if you ever need assistance with your lessons. Your exams will be graded and sent back to you within 24 hrs.

(800) 321-2155 or visit **www.ciebookstore.com**

CIE Bookstore: 1776 E. 17th, Cleveland, OH 44114 **CA, HI & OH** residents must add sales tax. **$5.25** shipping.

2-Channel 20 MS/s Scope

US$ 199.–

Options	
PC Software V2.0 incl. Adapter Cable	69.00
Signal Probe 1:1/10:1 60MHz	14.90
Rubber Protection Boot	19.90
AC Adapter	9.90
hard-shell anti-static carry case	39.90
Complete Set Scope + options (2 Probes)	349.00

Wittig Technologies

Wittig Technologies, Inc.
266 East Meadow Avenue
East Meadow, NY 11554
Phone (516) 794 4080, Fax (516) 794 1855
www.wittigtechnologies.com

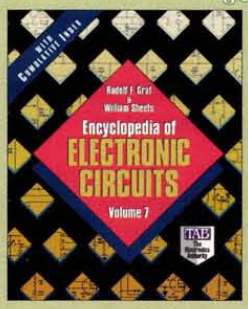
Buy This Book

It's huge! It has over *1,000* circuits. At $39.95, that's only about 4 cents each!

How can you go wrong?

"Encyclopedia of Electronic Circuits" Vol 7

ONLY $39.95 by Rudy Graff Over 1,100 Pages!



Designed for quick reference and on-the-job use, the Encyclopedia of Electronic Circuits, Volume 7, puts over 1000 state-of-the-art electronic and integrated circuit designs at your fingertips. Organized alphabetically by circuit type, this collection includes designs from industry giants such as Advanced Micro Devices, Motorola, Teledyne, General Electric, and even right here in *Nuts & Volts*.

As a paid subscriber to *Nuts & Volts*, you'll receive **10%** off the list price!!

(See ad on page 83 for ordering details and other titles currently available.)

Graphic Interface With Touch Screen

Priced From $140 w/Touch QTY 1

Graphic display
Touch screen (optional) or 12x12 input matrix
Serial communication (RS-232C)
Eprom or Flash for screen storage
Only +5VDC power required (or 9-26VDC)
Includes graphic controller board
Easy to use development software
Powerful friendly instruction interpreter
Create screens by PC paintbrush
Holds 100's of "canned" graphic screens
Simple to place touch buttons software
Easy interface with PC/104, 8051, 68HC11, PIC
Embedded Computer Controller Also Available

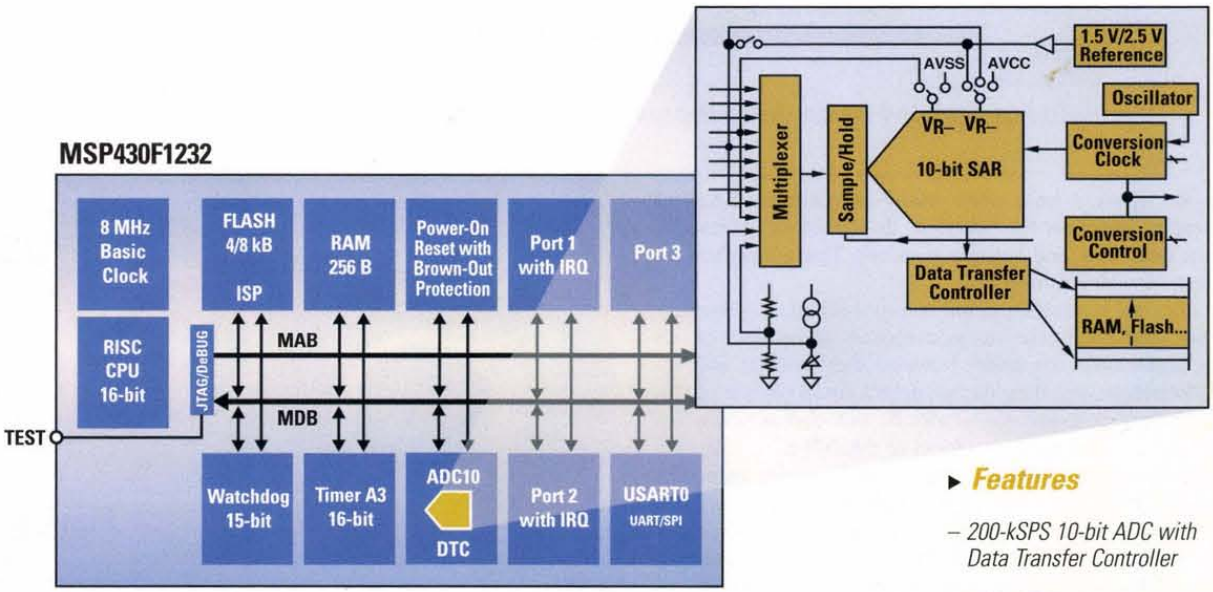
Easy Operator Interface through serial connection

Designtech Engineering Co.
2001 S. Blue Island Ave.
Chicago IL 60608
Phone 312-243-4700
Fax 312-243-4776
WWW.DESIGNTECHENGINEERING.COM

Circle #71 on the Reader Service Card.

Circle #72 on the Reader Service Card.

MSP430 offers 50X more throughput.



MSP430—the choice in ultra-low-power Flash MCUs

Experience the ultimate SOC solution for battery-powered measurement. A flexible clock system switches from ultra-low-power standby to high-performance signal processing in less than 6 µs. Embedded emulation reduces design cycle time. Get your design started today with the easy-to-use MSP-FET430P120 Flash emulation tool.

Device	Flash	RAM	I/O	WDT	Timer_A	USART	ADC	Price
MSP430F1232	8 kB	256	22	✔	✔	1	10-bit	$2.79
MSP430F1222	4 kB	256	22	✔	✔	1	10-bit	$2.62
MSP430F1132	8 kB	256	14	✔	✔	–	10-bit	$2.48
MSP430F1122	4 kB	256	14	✔	✔	–	10-bit	$2.24

MSP-FET430P120 development tool-**$99**

MSP-FET430P120 development tool for $99, product bulletin, F12x2 Datasheet and FREE samples

▸ *Features*

- *200-kSPS 10-bit ADC with Data Transfer Controller*
- *8-kB ISP Flash*
- *0.8-µA standby mode, 250-µA active mode*
- *On-board brown-out detector*
- *USART can be used in UART/SPI™ mode*

▸ ***www.ti.com/sc/hpa7554u***

1-800-477-8924 ext. 7554

THE WORLD LEADER IN DSP AND ANALOG

TEXAS INSTRUMENTS

The red/black banner is a trademark of Texas Instruments. SPI is a trademark of Motorola. 56-5729

© 2001 TI

Devantech SRF04 Ultrasonic Range Finder

By Kerry Barlow

Devantech has designed a nice detector package in their SRF04 Ultrasonic Range Finder.

Over the years, I have used many different methods of obstacle detection for robotics. IR detectors, ultrasonic range detectors, and bumper switches. These detectors all have their place in robotics.

Bumper switches are an excellent and cheap method of protection for your robot, but they don't offer range detection. IR sensors based on the can type digital units are good, however they are not entirely useful for range detection, and they do not detect small narrow obstacles well. Solid walls are detected easily with IR, but narrow obstacles cannot be detected with them with any form of reliability.

The Sharp GP series detectors are very good for range detection within three feet, and they are very good for large object detection, but again they fail in detecting narrow objects. By narrow objects, I am referring to items such as chair legs, or small trees and fence posts.

The Devantech SRF04 Ultrasonic Range Finder overcomes all of the failings I have listed above and, in fact, can replace most other detection sensors on your robot. Acroname sells this ranger for $25.00. The SRF04 can be seen mounted on my Mars Rover. It is mounted at the front under the large solar panel. You can see the two transducers pointing forward. The optional housing that Acroname sells has not been used in this application. The rover is Stamp BS2 controlled. The SRF04 provides all the sensor input that is used for obstacle avoidance.

On indoor robots, I have always struggled with the problem of a robot driving into a chair leg. Bumper switches will, of course, solve this problem, however I wanted a means of not using any mechanical switches. On an outdoor robot, there would be problems with detection systems not doing their job and the robot would wander into a tree or signpost. Some methods of overcoming this pitfall are: overlapping sensors, multiple sensor readings, rotating sensor modules, different types of sensors on board, and the final back-up — a bumper switch.

Devantech has designed a nice detector package in their SRF04 Ultrasonic Range Finder. This ranger is a small printed circuit board 1.5" by .75" with two small round transducers mounted to the board. One transducer outputs a signal and the second transducer receives this signal, and calculates a distance measurement. The output is then sent to the microcontroller in the form of a digital word. Acroname sells the Devantech SRF04 Ultrasonic Range Finder among many other very nice robotics parts, including motors, gears, and sensors. Acroname also has many nice informative robotics articles and information. There is also a nice housing Acroname sells. Refer to Figure 5 for a picture. The housing will go around the SRF04 to finish off your project, and it can hold two different sensor units. The sensor pairs may be adjusted from 15-25 degrees apart. Please refer to the table of links for the Acroname website address.

The SRF04 has a range of 3cm to three meters and

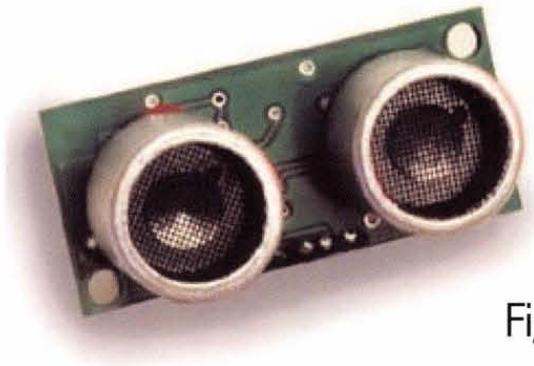


Figure 1

can detect a 3cm object at two meters. The basic operation and use of the SRF04 is very simple. The microprocessor must send an initialization command of 10 microseconds, followed by a receive or pulsin command. This pulsin command will store the SRF04 value in a word variable of your choosing and you may then do anything you wish with this value. The SRF04 may be left operating, and a thin broom handle can be passed in front of the sensor. The sensor will detect the broom handle100% of the time. Please refer to the table of specifications for more detailed information.

For those interested, the theory of operation is as follows. (Acroname's own description has been used.) The ranger works by transmitting a pulse of sound outside the range of human hearing. This pulse travels at the speed of sound away from the ranger in a

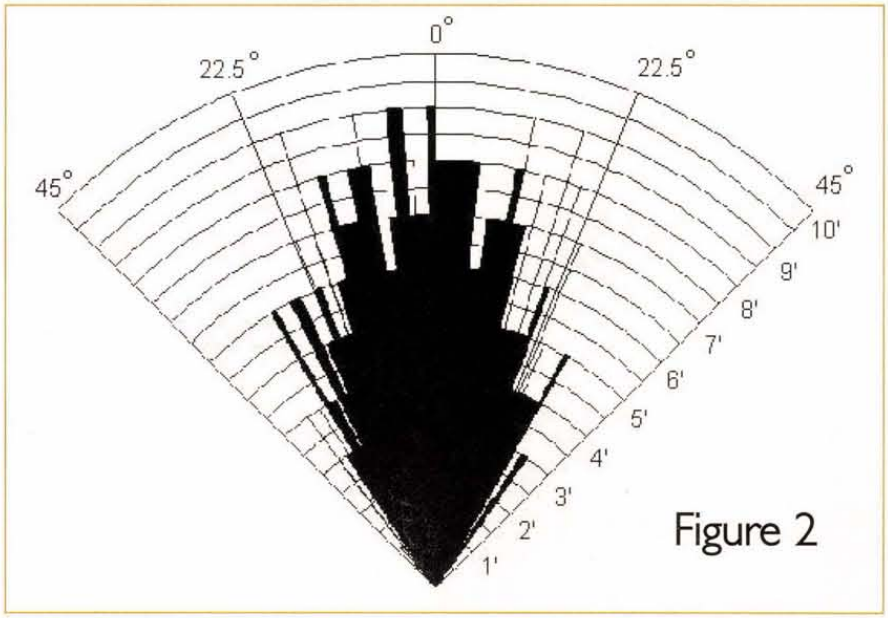


Figure 2

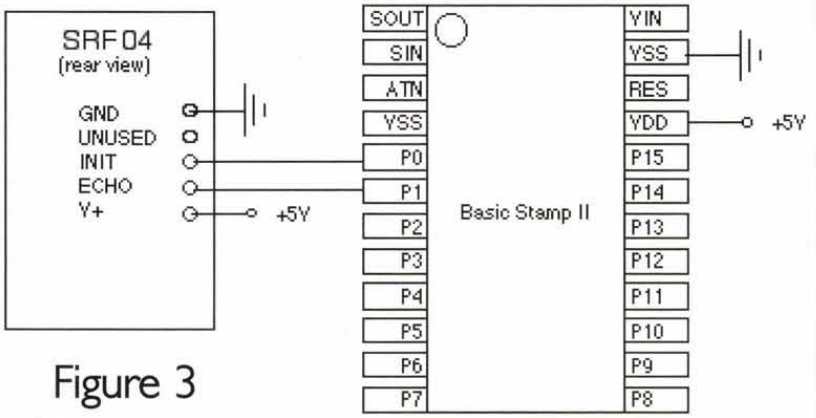


Figure 3

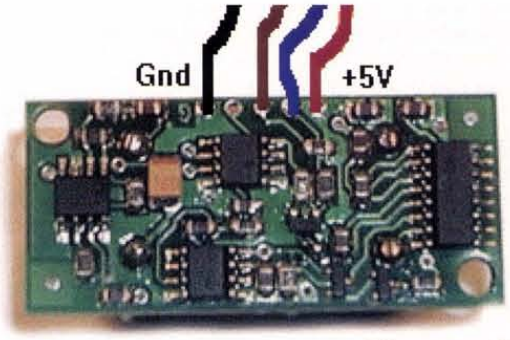


Figure 4

cone shape and the sound reflects back to the ranger from any object in the path of this sonic wave. The ranger pauses for a brief interval after the sound is transmitted, and then the ranger awaits the reflected sound in the form of an echo. The controller driving the ranger then requests a ping, the ranger creates the sound pulse, and waits for a return echo. If received, the ranger reports this echo to the controller and the controller can then compute the distance to the object based on the elapsed time.

Acroname has tested this sensor and found that it has a 30-degree cone of detection. In my real world use, I have found 30 degrees to be an adequate range of detection. I have used this sensor both indoors and outdoors. Please refer to Figure 2 for a beam pattern as tested by Acroname. The radial lines in the pattern are 6" increments. On one indoor robot, I do not even use the range sensing capability in my software. I simply want a detection of an object in front of the robot. This is okay too, as the SRF04 will detect the narrow objects nicely.

The SRF04 will work with any microprocessor. I have used the SRF04 with the Basic Stamp II and found no difficulties using it. Devantech specifications state that the sensor may draw up to 50 mA when in use. The voltage regulator on a Stamp is rated for 50 mA, so you will need an external power supply for operation. This is no problem, as robotics users will already have an external regulated power supply on board.

In testing, the SRF04 has been powered directly off the Stamp regulator, but it is not recommended for long term use. The SRF04 requires four connections for operation: +5V, ground, and the two signal wires. Please refer to Figure 3 for a wiring chart, connecting the SRF04 to a Basic Stamp. The SRF04 does not have any wires attached; you will be required to solder four wires to the SRF04 circuit board.

Wire holes are drilled in the board. No difficulty was encountered in actually soldering the wires to the board. Five holes are drilled in the SRF04, with one of the holes not being used. Acroname has a wiring chart in their printed manual, however a note about the diagram is in order. To use the wiring chart printed in the manual, you must know that the drawing is of the SRF04 with the two round transducer modules underneath the drawing in the manual. Place your sensor on a tabletop with the two round can shape transducers down and the five wire holes facing up. On the circuit board, there is a tiny G denoting the ground connection. Refer to Figure 4 for a wired SRF04. Please note that in Figure 4 +5V (red) is the right hand wire, Echo (blue) is the second wire, Init (brown) is the third wire, NC is the fourth hole, and ground (black) is the leftmost wire. I do not mean to belabor this point, but I myself lost some hair trying to figure out where the wires went from the printed manual.

The SRF04 will require two I/O lines from your microprocessor. The first sensor line is for initialization, and the second is for an echo/return line. For initial testing and design check-out, it is recommended to send the SRF04 sensor outputs directly to a debug window or a LCD display. Acroname has provided a very nice test program for the ranger that outputs the values to a debug window.

You will be able to get an idea of what the sensor is capable of this way because you can actually see its output. Listing 1 is a program provided by Acroname to send data to the debug screen. Acroname has recently released a new instruction manual that has different pro-

Table of Links

Acroname Sensors and Robotics parts: **http://www.acroname.com**
Devantech: **http://www.robot-electronics.co.uk/**
Devantech SRF04 Sensor from Acroname: R93-SRF04
SRF04 housing: R103-SRF04-HOUSING
Authors Email Address: **Admin@MntnWeb.Com**

Figure 5

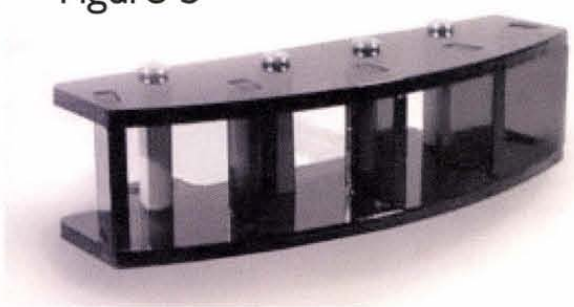


Table of Specifications

Beam Pattern	see graph
Voltage	5v
Current	30mA Typ. 50mA Max
Frequency	40KHz
Maximum Range	3 m
Minimum Range	3 cm
Sensitivity	Detect a 3cm diameter stick at > 2 m
Input Trigger	10uS Min. TTL level pulse
Echo Pulse	Positive TTL level signal, width proportional to range.
Weight	0.4 oz.
Size	1.75" w x 0.625" h x 0.5" d

gram code segments for the BASIC Stamps dated September 1st. This is to work around some of the timing problems associated with the Stamp controllers. Acroname also has a corrected program on their website for the Stamp timing issues, as well. Listing 1 shows two methods of controlling the Stamp, with the second section sr_sonar_2 being the program code which worked for my Stamp. I could not make the Stamp work on the first section's code example sr_sonar. Note: The execution time of the pulsin instruction will be slightly different for different Stamp pins. If you change the pin assignments, the pulsin command in the sr_sonar subroutine above may miss the rising edge of the ECHO input and return some readings of 0.

Using rctime instead of pulsin may fix this problem. Another trick is to introduce a small delay with a dummy command before measuring the echo time with the rctime command. This is illustrated in the alternate subroutine sr_sonar_2. You may need to experiment to determine the best code for your application. As stated earlier, the sr_sonar_2 code worked best on my Stamp II. I tried the SRF04 on various pins of my Stamp, and did not see any problems when using the sr_sonar_2 code.

A second method for testing is to send the sensor's output to your Stamp and then generate a tone output based on the range detection. Listing 2 is an example of the tone generation program.

For testing purposes, I connected a small portable Stamp, the

Continued on Page 71

GLOBAL POSITIONING SYSTEM RECEIVER

CUSTOMERS SAY THEY ARE USING THEM FOR:

HEWLETT PACKARD/TRIMBLE Z3801A
6 CHANNEL SMARTCLOCK TECHNOLOGY

TIMING, FREQUENCY REFERENCE & PRECISION (ACCURATE TO 3 BILLIONTHS OF A SECOND)
NAVIGATING BOATS
HAM RADIO
WEATHER MACHINE
MAPPING DEVICE FOR LAND USE:
IN A CAR
HIKING (HOOK UP TO A LAPTOP W/ DATA CABLE AND NAVIGATE WHICH MOUNTAINS YOU WILL CLIMB)
SYNCHRONIZES WITH GPS SATELLITES

$399!

QUANTITY DISCOUNTS- CALL YOUR SALES REP!

GPS RECEIVER

Visit us on the web at http://www.hitechcafe.com

HiTechCafe.com
25 Years in the business
100,000 sq. ft of Inventory

1-800-708-2867
945-A Spice Island Drive Sparks, Nevada 89431
Free Tech support on all products
1-775-356-8289

Circle #60 on the Reader Service Card.

www.gatewayelex.com
(Electronically Speaking, Gateway's Got It!)

gateway ELECTRONICS, INC

MAIL ORDERS CALL TOLL-FREE 1-800-669-5810

Circle #62 on the Reader Service Card.

PICmicro MCU development tools from microEngineering Labs, Inc.
www.melabs.com

LAB-X Experimenter Boards

Assembled development platforms. Each has RS-232 serial port, in-circuit programming connector, power supply, plus other hardware.

LAB-X1 for 40-pin (shown) - $199.95
LAB-X2 for 28 or 40-pin MCUs - $69.95
LAB-X3 for 18-pin MCUs - $119.95

PicBasic and PicBasic Pro Compiler

Write programs for PICmicro MCUs in BASIC. Can be used in Windows or DOS (includes Windows editor/IDE software).
PicBasic Compiler - $99.95
PicBasic Pro Compiler - $249.95

EPIC Plus PICmicro Programmer

Programs the following PICmicro MCUs: PIC12Cxxx, 12CExxx, 14C000, 16C505, 16C55x, 6xx, 7xx, 84, 9xx, 16CE62x, 16F62x, 7x, 8x, 87x, 17C7xx, and 18Cxxx (some MCUs require adapters). Software for Windows and DOS. Requires two 9V batteries or AC adapter (not included). Adapters available for various device packages.

Bare PCB w/software - $34.95, Assembled - $59.95
Assembled w/AC adapter, cable and ZIF adapter - $99.95

PICProto Prototyping Boards
$8.95 to $19.95

High-quality blank prototyping boards for PICmicro MCUs. Holds your microcontroller, 5-volt regulator, oscillator, capacitors, DB9-25 connector.

microEngineering Labs, Inc.
Phone: (719) 520-5323
Fax: (719) 520-1867
Box 60039, Colorado Springs, CO 80960

For product information or to order online, visit our website at: www.melabs.com

Circle #59 on the Reader Service Card.

Future Horizons
Advanced Technology

Ambient Power Module

Low cost circuit provides up to 9 watts of electrical power from free-energy in the air. Can replace batteries in many devices.
#PWRM Plans- $24.00
#PWRZ Ready to use- $140.00

Electronic Mind Control

Control minds with this simple technology. Others will do anything you program them to. Get that raise you always wanted or reprogram your mind.
#MIND Info/plans- $22.00
#MINZ Ready to use- $190.00

Cordless Phone Extender

Extend your cordless phone range to 50 miles. Place calls all around town. Great alternative to cell phones.
#CPHE Plans- $23.00

Ion Phaser

Device emits an electrified stream of special conductive fluid carrying 30,000 volts capable of stunning an individual from 20 feet away. battery powered Handheld non-lethal device.
#IPHA Plans- $49.00
#IPHZ Ready to use- $990.00

Traffic Light Buster

Has been known to turn traffic lights green in many cities by the touch of a button. Emergency vehicles use it to pass through traffic lights quickly. Opens security gates in gated communities too.
#TLBU Plans- $20.00
#TLBZ Ready to use- $250.00

Please add $6.00 Shipping/handling

Call for a FREE Catalog

Po Box 125 Marquette, Mi 49855
(906) 249-5197 www.futurehorizons.net

Circle #61 on the Reader Service Card.

Celebrating our 19th Year Of Service !!

VISIT US AT WWW.UNICORNELECTRONICS.COM

What Do We Have ?

• TTL	• 74LS	• 74C
• EPROMS	• EEPROMS	• PAL's
• GAL's	• CMOS	• Z80
• Linear	• Generators	• 8000 series
• 6500 series	• 6800 series	• Capacitors
• Oscillators	• Connectors	• Crystals
• Trimpots	• I.C. sockets	• Switches
• Diodes	• Kits	• Tools
• Vises	• Laser Diodes	• LED's
• Vises	• Transistors	• Resistors

• And much, much more!

• Order Line — (800) 824-3432 • International — (724) 495-1230 • Fax Orders — (724) 495-7882 • Technical Support — (724) 495-1231 • $25.00 Minimum Order • UPS 3 day, Blue, Red, & Fed. Ex. Shipping Available (Call for charges) • PA Res. Add 7 % Sales Tax • Open Mon-Fri 9:00 AM - 5:00 PM (EST) • Corporate Accounts / Quantity Discounts Available • We accept M/C, VISA, Discover & AMEX with no surcharge • Call For FREE Catalog ($2.00 Outside U.S.)

• We Carry A Complete Line Of Electronic Components • Email - unielect @ aol.com

Visit us on the web ! www.unicornelectronics.com

FREE SHIPPING!! on pre-paid orders

Unicorn Electronics
1142 State Route 18
Aliquippa, PA 15001

Circle #58 on the Reader Service Card.

Published Monthly By
T & L Publications, Inc.
430 Princeland Court
Corona, CA 92879-1300
(909) 371-8497
FAX (909) 371-3052

E-Mail — editor@nutsvolts.com
URL — http://www.nutsvolts.com

Subscription
Order ONLY Line
1-800-783-4624

PUBLISHER
Jack Lemieux *N6ZTD*

EDITOR
Larry Lemieux *KD6UWV*

MANAGING EDITOR
Robin Lemieux *KD6UWS*

CONTRIBUTORS
Robert Nansel
Jon Williams
Jeff Eckert
TJ Byers
Stanley York
Gordon West
Bob Vun Kannon
Michael Simpson
Anthony Caristi
Louis Frenzel
Kerry Barlow
George/Rachel/Thomas Philips
Robert Lang
Thomas Ober

ON-THE-ROAD EXHIBIT COORDINATOR
Audrey Lemieux *N6VXW*

STAFF
Natalie Sigafus
Mary Gamar

Copyright 2002 by
T & L Publications, Inc.
All Rights Reserved

All advertising is subject to publisher's approval. We are not responsible for mistakes, misprints, or typographical errors. Nuts & Volts Magazine assumes no responsibility for the availability or condition of advertised items or for the honesty of the advertiser. The publisher makes no claims for the legality of any item advertised in Nuts & Volts. This is the sole responsibility of the advertiser. Advertisers and their agencies agree to indemnify and protect the publisher from any and all claims, action, or expense arising from advertising placed in Nuts & Volts. Please send all subscription orders, correspondence, UPS, overnight mail, and artwork to: **430 Princeland Court, Corona, CA 92879.**

Reader Feedback

Dear Nuts & Volts

I read your article on the Blab Blaster with interest because I developed a similar project last year. Mr. Jim Cassedy was correct in his letter in your March issue where he stated that speech compression is used on commercials. My system used a PIC 16C73A/JW microprocessor with a LM386N amplifier and a small microphone. I used the microprocessor's A/D converter to take samples of the volume level over a several second interval and then calculate the average value of the recorded peaks. If the calculated value was too high, the processor sends the signal to decrease volume via an infrared LED that sends encoded volume up/down bursts for my particular TV set. I establish the correct level by pushing an up/down control on the unit that sends bursts of infrared to control the volume level. The PIC then "listens" for a period of time after the last button push and then maintains that volume level both up and down. The beauty of this system is that it is wireless and can be adjusted at any time from your viewing location. I also wrote an algorithm that could capture volume up and volume down code from any remote control and then duplicate it using the PIC.

Bruce Cambern
Madera, CA

Dear Nuts & Volts

I just got around to reading the January 2002 issue all the way through and I think the gremlins did it to you again in Stamp Applications. On Page 1, you were told to "vdd (+5) through a 10 KW resistor" and "insert a 1 KW resistor" and "through a 1 KW resistor." On Page 2 in two lines "the normal 1 KW resistance is divided (two 470 W resistors are close enough) and the 10 KW resistor will" and in Figure 3, you have P5 going to both DB4 and DB5 on the LCD.

I don't think the students and experimenters can get 10 KW or 1 KW or 470 W resistors. I haven't seen any of that size in a looooooooong time.

normdoty@bellsouth.net

Editor's Note:

Lost in the transmission ...
In last month's article by Murugavel Raju on using Texas Instrument's MSP430, there were a couple measurements that got changed inadvertently. The quantity "25µs" was changed to "25mS" in three different places: once under "Circuit Description" and twice in "Math_calc." Also, on page 37 of the same article, in the first and second to last paragraphs under the "Conclusion" section, two symbols needed to actually be micro amps. One read 300mA instead of 300MA and in the first sentence of the second paragraph, it should have read 2.1MA instead of 2.1mA. We apologize for any confusion this may have caused.

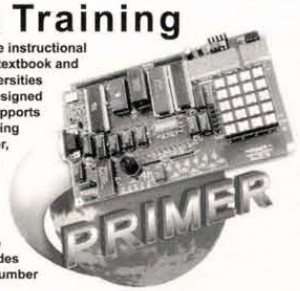
DMOS
&
JFETS
&
MOSFETS
&
TRANSISTORS
@
LINEARSYSTEMS
Second Source Replacments for Interfet, Motorola, National, Siliconix
◆ Custom Screening
◆ Die, SMT, Thru-Hole
LINEAR SYSTEMS
Full Service U.S. Manufacturer of Specialty Linear Products
4042 Clipper Court
Fremont, CA 94538
(TEL)510-490-9160
(FAX)510-353-0261
JFETS@LINEARSYSTEMS.COM
WWW.LINEARSYSTEMS.COM

Circle #99 on the Reader Service Card.

Check out the newest "editions" to the Nuts & Volts Book Store.
See our ad on Page 26!

Microprocessor
Hands-On Training

The PRIMER Trainer is a flexible instructional tool featured in a Prentice Hall textbook and used by colleges and universities around the world. Ruggedly designed to resist wear, the PRIMER supports several different programming Languages including Assembler, Machine Language, C, BASIC, and FORTH. A comprehensive Instruction Manual contains over 25 lessons with several examples of program design and hardware control. The Applications Manual provides theory and sample code for a number of hands-on lab projects.



Application Projects Include:
- Scan Keypad Input & Write to a Display
- Detect Light Levels with a Photocell
- Control Motor Speed using Back EMF
- Design a Waveform Generator
- Measure Temperature
- Program EPROMs
- Bus Interface an 8255 PPI
- Construct a Capacitance Meter
- Interface and Control Stepper Motors
- Design a DTMF Autodialer / Remote Controller

The PRIMER can be purchased as an unassembled kit ($120) or as an assembled/tested kit ($170). Upgrades provide battery-backed RAM and PC connectivity via an RS232 serial port (shown in picture). Additional options include a heavy-duty keypad (shown in picture) and a 9V power supply -- see our website. Quantity discounts are available. Satisfaction guaranteed.

Since 1985 OVER 16 YEARS OF SINGLE BOARD SOLUTIONS

EMAC, inc.
Phone 618-529-4525 Fax 618-457-0110
2390 EMAC Way, Carbondale, Illinois 62901
World Wide Web: http://www.emacinc.com

Circle #100 on the Reader Service Card.

USB DAQ

LabJack™
U12
$99

* 12-bit analog inputs
* 10-bit analog outputs
* 20 digital I/O
* 32-bit counter
* Watchdog function
* Built-in screw terminals
* Easy-to-use USB
* Everything included
* Use with C, VB, LabVIEW
* Windows 98SE/ME/2000/XP

LabJack Corporation
info@labjack.com
(303) 942-0228

www.labjack.com

WE BUY AND SELL

WESTERN TEST SYSTEMS

Inquiries **307-635-2269** • Fax **307-635-2291**

Orders **800-538-1493**

2701 Westland Court, Unit B, Cheyenne, Wyoming 82001

OSCILLOSCOPES & ACCESSORIES

OSCILLOSCOPES

PROBES

TEKTRONIX 1101 Accessory Power Supply, for FET probes $175.00
TEKTRONIX A6902B Voltage Isolator, DC-20 MHz, 20 mV-500 V/division $500.00
TEKTRONIX P6201 900 MHz 1X/ 10X/ 100X FET Probe $400.00
TEKTRONIX P6202 500 MHz 10X FET Probe $150.00

WAVEFORM GENERATORS

FUNCTION GENERATORS

HP 3310A 5 MHz Function Generator $250.00
HP 3325A-001 21 MHz Synthesizer/Function Generator, OCXO ref. $1100.00
HP 3325A-002 21 MHz Synthesizer/Function Generator, high voltage $1200.00
HP 3325B-002 Synthesizer/ Function Generator, 1 uHz-21 MHz, HPIB $4000.00
TEKTRONIX AWG5102 Arb. Waveform Gen., 20 MS/s, 12 bits, 50 ppm synthesis <1MHz $650.00
TEKTRONIX AWG5102-opt.2 Arbitrary Waveform Generator, dual channel option $800.00
TEKTRONIX DD501 Digital Delay & Burst Gen., for function & pulse gen's $200.00
TEKTRONIX FG5010 Programmable 20 MHz Function Generator, TM5000 series $600.00
TEKTRONIX FG502 11 MHz Function Generator, TM500 series $275.00
TEKTRONIX FG503 3 MHz Function Generator, TM500 series $250.00
TEKTRONIX RG501 Ramp Generator, TM500 series $175.00
WAVETEK 288 20 MHz Synthesized Function Generator, GPIB $650.00

PULSE GENERATORS

BERKELEY NUC. 7085B Digital Delay Gen., 0-100 mS, 1 nS res., 5 Hz-5 MHz $400.00
HP 214B 10 MHz Pulse Generator, up to 50V/ 50 Ohms $1200.00
HP 214B-001 10 MHz Pulse Generator, pulse counting option $1400.00
HP 8007B 100 MHz Pulse Generator $450.00
HP 8012B 50 MHz Pulse Generator, variable transition time $600.00
HP 8013A 50 MHz Dual Output Pulse Generator $500.00
HP 8013B 50 MHz Dual Output Pulse Generator $600.00
HP 8112A 50 MHz Pulse Generator, HPIB $3000.00
HP 8116A-001 50 MHz Pulse/Function Generator, burst & log sweep option $3500.00
TEKTRONIX PG502 250 MHz Pulse Generator, TM500 series $500.00
TEKTRONIX PG508 50 MHz Pulse Generator, TM500 series $350.00

VOLTAGE & CURRENT

VOLTMETERS

FLUKE 845AR High Impedance Voltmeter / Null Detector $350.00
HP 3456A 6-1/2 digit Voltmeter, HPIB $450.00
HP 3457A 7-1/2 digit Voltmeter, HPIB $1000.00
HP 3478A 5-1/2 digit Multimeter, HPIB $450.00
KEITHLEY 181 6-1/2 digit Nanovoltmeter, 10 nV sensitivity, PIB $675.00
TEKTRONIX DM5010 4-1/2 digit Multimeter, TM5000 series $300.00
TEKTRONIX DM501A 4-1/2 digit Multimeter, TM500 series $225.00

CALIBRATION

FLUKE 510A AC Reference Standard, 10 VRMS, 0-10 mA $450.00
FLUKE 5220A Transconductance Amplifier, DC-5 kHz, 0-20 A $1250.00

VOLTAGE SOURCES

HP 6114A Precision Power Supply, 0-20 V 2 A/ 0-40 V 1 A $650.00
HP 6115A Precision Power Supply, 0-50 V 0.8A/ 0-100 V 0.4A $650.00
TEKTRONIX PS5004 Precision Power Supply, 0-20 V 0-300 mA, mV res. $950.00

CURRENT METERS & SOURCES

HP 4140B DCV Source / Picoammeter, HPIB $3500.00
HP 6177C DC Current Source, to 50 V, 500 mA $500.00
HP 6181C DC Current Source, to 100 V, 250 mA $500.00
KEITHLEY 225 Current Source, 0.1 uA-100 mA, 10-100 V compliance $450.00
TEKTRONIX P6022 AC Current Probe, 935 Hz-120 MHz, 6 A peak $250.00
VALHALLA 2500 AC/DC Current Calibrator, 2 uA-2 A, DC-10 kHz $500.00

IMPEDANCE & COMPONENT TEST

L.C.R.

BOONTON 62AD 1 MHz Inductance Meter, 2-2000 uH $500.00
BOONTON 72BD 1 MHz Capacitance Meter, 2-2000 pF f.s. 3 digits $800.00
BOONTON 72C 1 MHz Capacitance Meter, 1-3000 pF f.s. analog $800.00
GENERAL RADIO 1658 RLC Digibridge, 120 Hz / 1 kHz $1000.00
HP 4262A 3-1/2 digit LCR Meter, 120 Hz/ 1 kHz/ 10 kHz $950.00
HP 4274A 5-1/2 digit LCR Meter, 100 Hz-100 kHz, HPIB $3250.00

STANDARDS

E.S.I. SR-1 Standard Resistor, various values $125.00
E.S.I. SR1010 Resistance Transfer Standards, 1 Ohm-100 K/step .. $500.00
GENERAL RADIO 1406-series Standard Air Capacitors, GR900 connector, 0.1% acc $275.00
GENERAL RADIO 1409-series Standard Capacitors, 0.001-1.0 uF values available $150.00
GENERAL RADIO 1433-J 4-Decade Resistor, 0-11.11 Kilohms, 1 Ohm steps $150.00
GENERAL RADIO 1433-K 4-Decade Resistor, 0-1.11 Kilohms, 0.1 Ohm steps $150.00
GENERAL RADIO 1433-P 5-Decade Resistor, 0-1.1111 Megohms, 10 Ohm steps $200.00
HP 4440B Decade Capacitor, 40 pF-1.2 uF $750.00

HI & LO RESISTANCE

HP 4329A High Resistance Meter, 500 Kilohms-2x 10e16 Ohms $875.00

T.D.R.

TEKTRONIX 1503B-03,04 TDR, 0-50,000 feet; chart rec. & battery options $2500.00

POWER SUPPLIES

SINGLE OUTPUT

HP 6002A-001 0-50 V / 0-10 A / 200 Watts max. Supply, HPIB $650.00
HP 6011A 0-20 V/ 0-120 A/ 1000 Watts max., CV/CC Supply $1800.00
HP 6028A 0-60 V/ 0-10 A/ 200 Watts max. Autoranging Supply $1000.00
HP 6033A 0-20 V/ 0-30 A/ 200 Watts max. Supply, HPIB $1200.00
HP 6038A 0-60 V/ 0-10 A/ 200 Watts max Supply, HPIB $1200.00
HP 6203B 0-7.5 V 0-3 A CV/CC Power Supply $175.00
HP 6205C Dual Power Supply, 0-40 V 300 mA/ 0-20 V 600 mA $300.00
HP 6207B 0-160 V 0-200 mA CV/CC Power Supply $200.00
HP 6263B 0-20 V 0-10 A CV/CC Power Supply $375.00
HP 6266B 0-40 V 0-5 A CV/CC Power Supply $375.00
HP 6267B 0-40 V 0-10 A CV/CC Power Supply $550.00
HP 6271B 0-60 V 0-3 A CV/CC Power Supply $375.00
HP 6274B 0-60 V 0-15 A CV/CC Power Supply $650.00
HP 6384A 4.0-5.5 V at 8 A CV/CL Power Supply $125.00
HP 6443B 0-120 V 0-2.5 A CV/CC Power Supply $375.00
HP 6525A 0-4000 V 0-50 mA CV/CC Power Supply $650.00
HP 6552A 0-20 V 0-25 A CV/CC Power Supply $1000.00
HP 6643A 0-35 V 0-6 A CV/CC Power Supply, HPIB $1200.00
HP 6651A 0-8 V 0-50 A CV/CC Power Supply, HPIB $1500.00
HP 6652A 0-20 V 0-25 A CV/CC Power Supply, HPIB $1875.00
KEPCO ATE 36-8M 0-36 V 0-8 A CV/CC Power Supply $300.00
SORENSON SRL 20-12 0-20 V 0-12 A CV/CC Power Supply $350.00
SORENSON SRL 60-8 0-60 V 0-8 A CV/cc Power Supply $450.00

MULTIPLE OUTPUT

HP 6228B Dual Power Supply, 0-50 V 0-1 A, CV/CC $375.00
HP 6236B Triple Output Supply, +/-20 V 0.5A & 0-6 V 2.5 A $375.00
HP 6237B Triple Output Supply, +/-20 V 0.5 A & 0-18 V 1 A $375.00
HP 6253A Dual Power Supply, 0-20 V 0-3 A, CV/CC $375.00
HP 6255A Dual Power Supply, 0-40 V 0-1.5 A, CV/CC $375.00
HP 6627A Quad Output Power Supply, 0-20 V 2A or 0-50V 800mA $2750.00
TEKTRONIX PS503A Dual Power Supply, TM500 series $200.00

MISCELLANEOUS

ACME PS2L-500 Programmable Load, 0-75 V/ 0-75 A/ 500 Watts max. $300.00
ACME PS2L-500 Programmable Load, 0-75 V / 0-75 A / 500 Watts max $350.00
HP 6826A Bipolar Power Supply / Amplifier, +/-50 V 1 A max. $900.00
HP 6827A Bipolar Power Supply / Amplifier, +/-100 V +/-500 mA $900.00
KEPCO BOP 50-2M Bipolar Amplifier/ Power Supply, to 50 V, 2 A $400.00
TRANSISTOR DEV DAL-50-15-100 Programmable Load, 0-50 V, 0-15 A, 100 Watts max. $200.00

TIME & FREQUENCY

UNIVERSAL COUNTERS

HP 5314A 100 MHz/ 100 nS Universal Counter $175.00
HP 5315A 100 MHz/ 100 nS Universal Counter $350.00
HP 5315A-003 100 MHz/ 100 nS Counter, 1 GHz C-channel $450.00
HP 5315B 100 MHz/ 100 nS Universal Counter $375.00
HP 5316A 100 MHz/ 100 nS Universal Counter, HPIB $450.00
PHILIPS PM6672/ 411 120 MHz/ 100 nS Universal Counter, 1 GHz C-channel $300.00
TEKTRONIX DC5004 100 MHz/ 100 nS Counter/ Timer, TM5000 series $200.00
TEKTRONIX DC5009 135 MHz/ 10 nS Counter/ Timer, TM5000 series $350.00
TEKTRONIX DC503A 125 MHz/ 100 nS Universal Counter, TM500 series $250.00
TEKTRONIX DC509 135 MHz/ 10 nS Universal Counter, TM500 series $275.00

FREQUENCY COUNTERS

EIP 548A-06 26.5 GHz Frequency Counter & mixers for 26-60 GHz $3950.00
EIP 578-02,05 26.5 GHz Source Locking Counter, GPIB& power meter $2750.00
HP 5342A 18 GHz Frequency Counter $900.00
HP 5343A-001 26.5 GHz Frequency Counter, OCXO reference $2500.00
HP 5345A/55A/56B 26.5 GHz CW/ Pulse Frequency Counter $3500.00
HP 5352B-010 40 GHz Frequency Counter, OCXO reference option $7500.00
HP 5384A 225 MHz Frequency Counter, HPIB $450.00
XL MICROWAVE 3401 40 GHz Source Locking Frequency Counter, GPIB $5500.00

STANDARDS

HP 105B Quartz Oscillator, 0.1/ 1.0/ 5.0 MHz, battery pwr. $1100.00

AUDIO & BASEBAND

SPECTRUM ANALYSIS

HP 3586C Selective Level Meter, 50 Hz-32.5 MHz, 50& 75 Ohms $1000.00

DISTORTION ANALYZERS

HP 8903A Audio Analyzer, 20 Hz-100 kHz, HPIB $1200.00
HP 8903B-001,010,053 Audio Analyzer, 20 Hz-100 kHz, HPIB $1850.00
HP 8903E Audio Analyzer, 20 Hz-100 kHz, HPIB $1650.00

RMS VOLTMETERS

FLUKE 8922A True RMS Voltmeter, 180 uV-700 V, 2 Hz-11 MHz $450.00

OSCILLATORS

TEKTRONIX SG502 Sine/ Square Osc., 5 Hz-500 kHz, 70 dB step atten., TM500 ..... $200.00
TEKTRONIX SG505-opt.2 Oscillator, 10 Hz-100 kHz; IM test & 50/150/600 Ohms $800.00
WAVETEK 98 1 MHz Synthesized Power Oscillator, GPIB $750.00

MISCELLANEOUS

HP 3575A Phase-Gain Meter, 1 Hz-13 MHz, single display $600.00
HP 3575A-001 Phase-Gain Meter, 1 Hz-13 MHz, dual display $750.00
HP 467A Power Amplifier $375.00
KROHN-HITE 3200 High Pass / Low Pass Filter, 20 Hz-2 MHz $275.00
KROHN-HITE 3202 Dual HP/LP/BP/BR Filter, 20 Hz-2 MHz $450.00
ROCKLAND 852 Dual Highpass/ Lowpass Filter, 0.1 Hz-111 kHz $650.00
TEK AM502 1 MHz Differential Amplifier, TM500 series $450.00

RF & MICROWAVE

SPECTRUM ANALYZERS

HP 11517A/19A/20A Mixer Set, 18-40 GHz, for HP 8555A / 8569A $475.00
HP 11970A WR28 Harmonic Mixer, 26.5-40 GHz $1000.00
HP 11970K WR42 Harmonic Mixer, 18.0-26.5 GHz $1000.00
HP 11970Q WR22 Harmonic Mixer, 33-50 GHz $1400.00
HP 11970U WR19 Harmonic Mixer, 40-60 GHz $1600.00
HP 11971A WR28 Harmonic Mixer, 26.5-40 GHz, for 8569B $800.00
HP 11971K WR42 Harmonic Mixer, 18.0-26.5 GHz, for 8569B $800.00
HP 11974A WR28 Prselected Mixer, 26.5-40 GHz $8000.00
HP 11974U WR19 Preselected Mixer, 40-60 GHz $8500.00
HP 11975A L.O. Amplifier, 2-8 GHz $1400.00
HP 8562A Spectrum Analyzer, 1 kHz-22 GHz, 100 Hz min.res. Bw $16000.00
HP 85640A Tracking Generator, 300 kHz-2.9 GHz, for HP 8560 series $4000.00
HP 8565A-100 Spectrum Analyzer, 10 MHz-22 GHz, 100 Hz min. res. Bw $3000.00
HP 8569B Spectrum Analyzer, 10 MHz-22 GHz, 100 Hz min.res. Bw $4500.00
TEKTRONIX WM782V WR15 Harmonic Mixer, 50-75 GHz $1500.00

NETWORK ANALYZERS

HP 11650A Network Analyzer Accessory Kit $500.00
HP 11650A Network Analyzer Accessory Kit, APC7 ..... $600.00
HP 11665B Modulator, 0.15-18.0 GHz, for HP 8755/6/7 ..... $250.00
HP 11665B Modulator, 0.15-18 GHz, for HP 8755/6/7 ..... $250.00
HP 3577B Network Analyzer, 5 Hz-200 MHz $9500.00
HP 4191A RF Impedance Analyzer, 1-1000 MHz, 1 milliohm-100 Kilohms $3750.00
HP 4193A Vector Impedance Meter, 400 kHz-110 MHz, 10 Ohms-100 K $4500.00
HP 8502B 75 Ohm Transmission/ Reflection Test Unit, 0.5-1300 MHz $675.00
HP 85044B 75 Ohm Transmission/ Reflection Test Unit, 300 kHz-2 GHz $1250.00

Circle #48 on the Reader Service Card.

VISA

90 DAY WARRANTY PARTS AND LABOR • 10 DAY INSPECTION
TEST EQUIPMENT WANTED CALL OR FAX LIST • OPEN ACCOUNTS

MasterCard
AMERICAN EXPRESS Card

HP 85054A Type N Calibration Kit, for HP 8510 series **$1800.00**
HP 8717B-001 Transistor Bias Supply **$350.00**
HP 8751A-001,002 Network Analyzer, 5 Hz-500 MHz **$12500.00**
HP 8756A Scalar Network Analyzer, HPIB **$1375.00**
HP R85026A WR28 Detector, 26.5-40 GHz, for HP 8757 series **$1200.00**

SIGNAL GENERATORS

FLUKE 6060B/AK Signal Generator, 0.1-1050 MHz, 10 Hz res. ... **$1250.00**
FLUKE 6060B-130,830 Signal Generator, 0.1-1050 MHz, 10 Hz res., GPIB **$1600.00**
GIGATRONICS 1018 Signal/Sweep Gen., 0.05-18 GHz, 1 kHz res., +8 dBm **$5000.00**
GIGATRONICS 600/ 6-12 Synthesized Source, 6-12 GHz, 1 MHz res., GPIB **$1500.00**
GIGATRONICS 6000/ 8-16 Synthesized Source, 8-16 GHz, 1MHz res., GPIB **$2250.00**
GIGATRONICS 6061A-830 Signal Generator, 0.1-1050 MHz, 10 Hz res., AM, FM, GPIB **$1900.00**
HP 11707A Test Plug-in, for HP 8660 series **$400.00**
HP 11720A Pulse Modulator, 2-18 GHz, 80 dB on/off ratio **$450.00**
HP 8642M Signal Generator, 0.1-2100 MHz, 1 Hz res., HPIB **$3750.00**
HP 8656B-001 Signal Generator, 0.1-990 MHz, 10 Hz res., HPIB, OCXO **$2750.00**
HP 8657A Signal Generator, 0.1-1040 MHz, 10 Hz res., AM, FM, HPIB **$3000.00**
HP 8660C/603A/633B Signal Generator, 1-2600 MHz, 1 or 2 Hz res., AM, FM **$3250.00**
HP 8660D/86603A-002 Signal Generator, 1-2600 MHz, 1 or 2 Hz res., phase modulation **$6000.00**
HP 8671A Signal Gen., 2.0-6.2 GHz, 1 kHz res., CW, FM, +8 dBm, HPIB **$2750.00**
HP 8671B Synthesized Signal Generator, 2-18 GHz **$4000.00**
HP 8672A Signal Generator, 2-18 GHz, 1-3 kHz res., AM, FM, +3 dBm **$4500.00**
HP 8672A-008 Signal Generator, 2-18 GHz, 1-3 kHz res., AM, FM, +8 dBm **$5000.00**
HP 8673C Signal Gen., 0.05-18.6 GHz, 1 kHz res., AM, FM, Pulse, HPIB **$14000.00**
HP 8673D-H15 Signal Gen., 0.05-26 GHz, 1 kHz res., AM, FM, HPIB **$15000.00**
HP 8673H-212 Signal Generator, 2.0-12.4 GHz, 1 kHz res., AM, FM, +8 dBm **$8500.00**
HP 8673M Signal Generator, 2-18 GHz, 1 kHz res., AM, FM, +8 dBm **$9500.00**
HP 8683B Signal Generator, 2.3-6.5 GHz, cavity tuned, AM/ WBFM/ Pulse **$2250.00**
HP 8683D Signal Generator, 2.3-13.0 GHz, cavity tuned, AM/ WBFM/ Pulse **$3750.00**
HP 8684B Signal Generator, 5.4-12.5 GHz, cavity tuned, AM/ WBFM/ Pulse **$2250.00**
MARCONI 2019 Signal Generator, 80 kHz-1040 MHz, 10 or 20 Hz res **$850.00**
WAVETEK 955 Signal Generator, 7.5-12.4 GHz, +7 dBm, AM, FM **$750.00**
WAVETEK 957 Signal Generator, 12-18 GHz, +7 dBm, AM, FM **$750.00**

SWEEP GENERATORS

HP 8350B/ 83522A Sweep Oscillator, 10-2400 MHz, +13 dBm levelled **$3750.00**
HP 8350B/ 83525A Sweep Oscillator, 10 MHz-8.4 GHz, +13 dBm levelled **$5000.00**
HP 8350B/ 83540A-002 Sweep Oscillator, 2.0-8.4 GHz, 70 dB step atten. **$3250.00**
HP 8350B/ 83545A-002 Sweep Oscillator, 5.9-12.4 GHz, 70 dB step atten. **$3750.00**
HP 8350B/ 83570A Sweep Oscillator, 18.0-26.5 GHz, +10 dBm levelled **$7000.00**
HP 8350B/83570A-H22 Sweep Oscillator, 17-24 GHz, +10 dBm levelled **$5000.00**
HP 8620C Sweep Oscillator Frame **$500.00**
HP 86222B-002 RF Plug-in, 10-2400 MHz, +13 dBm, 70 dB step atten. **$1250.00**
HP 86222B-E69/8620C Sweep Osc. & frame, 0.01-2 GHz & 2-4 GHz bands **$1200.00**
HP 86240B RF Plug-in, 2.0-8.4 GHz, +13 dBm levelled **$450.00**
HP 86241A RF Plug-in, 3.2-6.5 GHz, +8 dBm levelled **$300.00**
HP 86245A RF Plug-in, 5.9-12.4 GHz, +16 dBm unlevelled **$350.00**
HP 86251A RF Plug-in, 7.5-18.6 GHz, +10 dBm levelled **$500.00**
HP 86260A RF Plug-in, 12-18 GHz, +10 dBm unlevelled **$400.00**
HP 86260A-H04 RF Plug-in, 10-15 GHz, +10 dBm unlevelled **$400.00**
HP 86290B RF Plug-in, 2.0-18.6 GHz, +10 dBm levelled **$1500.00**
HP 86290C RF Plug-in, 2.0-18.6 GHz, +13 dBm levelled **$1750.00**
WAVETEK 2001 Sweep Generator, 1-1400 MHz, +10 dBm, 70 dB atten. **$750.00**
WAVETEK 2002B Sweep Generator, 1-2500 MHz, +13 dBm, GPIB **$1750.00**
WILTRON 6647M Sweep Generator, 10 MHz-20 GHz, +10 dBm, GPIB **$4500.00**
WILTRON 6669B-02,03 Sweep Gen., 0.01-26.5 GHz/ K conn.& 26-40 GHz/ WR28 ..... **$7500.00**
WILTRON 6717B-20 Synthesizer/ Sweeper, 10 MHz-8.4 GHz, +13 dBm,GPIB **$6000.00**

POWER METERS

BOONTON 42B/ 41-4E Analog Power Meter, with 1 MHz-18 GHz sensor **$400.00**
HP 435B/8481A Power Meter, -30 to +20 dBm, 10 MHz-18 GHz **$900.00**
HP 436A-022/ 8481A Power Meter, -30 to +20 dBm, 10 MHz-18 GHz, HPIB **$1200.00**
HP 436A-022/ 8482A Power Meter, -30 to +20 dBm, 100 kHz-4.2 GHz, HPIB **$1200.00**
HP 436A-022/ 8484A Power Meter, -70 to -20 dBm, 10 MHz-18 GHz, HPIB **$1200.00**
HP 436A-022/ 8485A Power Meter, -30 to +20 dBm, 50 MHz-26.5 GHz, HPIB **$1500.00**
HP 436A-022/ 8485D Power Meter, -70 to -20 dBm, 50 MHz-26.5 GHz, HPIB **$1700.00**
HP 438A Dual Channel Power Meter **$3000.00**
HP 8477A Power Meter Calibtator, for HP 432 series **$400.00**
HP 8487D High Sensitivity Sensor, -70 to -20 dBm, 50 MHz-50 GHz, 2.4mm **$1850.00**
HP 8900D/84811A Peak Power Meter, 0.1-18 GHz, 0-20 dBm peak **$2500.00**
HP Q8486A Power Sensor, 33-50 GHz, -30 to +20 dBm, for 435/6/7/8 ..... **$1500.00**
HP R8486A Power Sensor, 26.5-40 GHz, -30 to +20 dBm, for 435/6/7/8 ..... **$1500.00**

HP R8486D Power Sensor, 26.5-40 GHz, -70 to -20 dBm, for 435/6/7/8 ..... **$1750.00**

RF MILLIVOLTMETERS

BOONTON 92C RF Millivoltmeter, 3 mV-3 V f.s., 10 kHz-1.2 GHz **$500.00**
RACAL-DANA 9303 RF Millivoltmeter, -70 to +20 dBm, 10 kHz-2 GHz, GPIB **$750.00**

AMPLIFIERS, MISCELLANEOUS

AMPLIFIER RESEARCH 4W1000 Amplifier, 40 dB gain, 4 Watts, 1-1000 MHz **$950.00**
BOONTON 82AD Modulation Meter, AM/ FM, 10-1200 MHz **$500.00**
C.P.I. VZC6961K1 TWT Amplifier, 35 dB gain, 4-8 GHz, 20 Watts **$3500.00**
ENI 525LA Amplifier, 50 dB gain, 1-500 MHz, 25 Watts **$3250.00**
HP 11713A Switch / Attenuator Driver, HPIB **$800.00**
HP 11729B-003 Carrier Noise Test Set, 5 MHz-3.2 GHz **$1900.00**
HP 3730B/3738B Downconverter, 5.9-8.9 GHz & 8.7-11.7 GHz **$1200.00**
HP 415E SWR Meter **$200.00**
HP 8347A RF Amplifier, 25 dB gain, 100 kHz-3 GHz, +20 dBm, HPIB **$2750.00**
HP 8349A Amplifier, 15 dB gain, 2-20 GHz, +20 dBm output **$1650.00**
HP 8403A-002 Pulse Modulator, 0.8-2.4 GHz, 80 dB dynamic range **$450.00**
HP 8406A Comb Generator, 1/ 10/ 100 MHz increments, to 5GHz . **$500.00**
HP 8447A-001 Dual Amplifier, 20 dB, 0.1-400 MHz, +6 dBm Po, NF <7 dB **$650.00**
HP 8447E Amplifier, 22 dB, 0.1-1300 MHz, +13 dBm output **$650.00**
HP 8447F-H64 Dual Amp., 0.01-50 MHz 28 dB & 0.1-1300 MHz 25 dB **$900.00**
HP 8901A Modulation Analyzer, 150 kHz-1300 MHz, HPIB **$1350.00**
HP 8901B-001 Modulation Analyzer, 150 kHz-1300 MHz, HPIB **$1900.00**
HUGHES 8010H13F000 TWT Amplifier, >30 dB gain, 3-8 GHz, 10 Watts **$2500.00**
MPD LAB-1-510-10 Amplifier, 48 dB gain, 500-1000 MHz, 10 Watts **$750.00**
RACAL 9009 Modulation Meter, 30-1500 MHz, AM, 1.5-100 kHz pk FM **$350.00**
RF POWER LABS ML50 Amplifier, 2-30 MHz, 47 dB gain, 50 Watts, metered, 28 V **$200.00**
ROHDE&SCHWARZ ESH2 Test Receiver, 9 kHz-30 MHz **$3250.00**

COAXIAL & WAVEGUIDE

AEROWAVE 28-3000/10 WR28 Directional Coupler, 10 dB, 26.5-40 GHz **$300.00**
AMERICAN NUC. AM-432 Cavity Backed Spiral Antenna, LHC, 2-18 GHz, TNC(f) *NEW* **$95.00**
AVANTEK AMT-400X2 WR28 Active Doubler, +10 dBm in & out **$450.00**
BIRD 8201 500 Watt Oil Dielectric Load, DC-2.5 GHz **$350.00**
FXR/MICROLAB SL-03N Stub Stretcher, 0.3-6.0 GHz, 100 Watts max., N(m/f) **$75.00**
GENERAL RADIO 874-LTL Constant Impedance Trombone Line, 0-44 cm, DC-2 GHz **$400.00**
HP 11590A-001 Bias Network, 1.0-18.0 GHz, APC7 ..... **$450.00**
HP 11691D Directional Coupler, 22 dB, 2-18 GHz, N connectors ... **$450.00**
HP 11692D Dual Directional Coupler, 22 dB, 2-18 GHz **$800.00**
HP 33327L-006 Prog. Step Attenuator, 0-70 dB, DC-40 GHz, 2.9mm **$1000.00**
HP 778D-011 Dual Dir. Coupler, 20 dB, 0.1-2.0 GHz, APC7 ..... **$450.00**
HP 8498A-030 30 dB Attenuator, 25 Watts, DC-18 GHz **$500.00**
HP 87300C-020 Directional Coupler, 20 dB, 1.0-26.5 GHz, 3.5mm **$475.00**
HP K422A WR42 Flat Broadband Detector, 18.0-26.5 GHz **$350.00**
HP K532A WR42 Frequency Meter, 18.0-26.5 GHz **$450.00**
HP K752A WR42 Directional Coupler, 3 dB, 18.0-26.5 GHz **$450.00**
HP K752C WR42 Directional Coupler, 10 dB, 18.0-26.5 GHz **$450.00**
HP K752D WR42 Directional Coupler, 20 dB, 18.0-26.5 GHz **$450.00**
HP K870A WR42 Slide Screw Tuner, 18.0-26.5 GHz **$275.00**
HP K914B WR42 Moving Load, 18.0-26.5 GHz **$250.00**
HP Q752D WR22 Directional Coupler, 20 dB, 33-50 GHz **$650.00**
HP R422A WR28 Crystal Detector, 26.5-40 GHz **$400.00**
HP R752A WR28 Directional Coupler, 3 dB, 26.5-40 GHz **$450.00**
HP R752D WR28 Directional Coupler, 20 dB, 26.5-40 GHz **$450.00**
HP R914B WR28 Moving Load, 26.5-40 GHz **$250.00**
HP V365A WR15 Isolator, 25 dB, 50-75 GHz **$750.00**
HP V752D WR15 Directional Coupler, 20 dB, 50-75 GHz **$650.00**
HP X870A WR90 Slide Screw Tuner **$150.00**
HUGHES 45322H-1110/1120 WR22 Directional Couplers, 10 or 20 dB, 33-50 GHz **$350.00**
HUGHES 45712H-1000 WR22 Frequency Meter, 33-50 GHz **$750.00**
HUGHES 45714H-1000 WR15 Frequency Meter, 50-75 GHz **$900.00**
HUGHES 45722H-1000 WR22 Direct Reading Attenuator, 0-50 dB, 33-50 GHz **$1000.00**
HUGHES 45724H-1000 WR15 Direct Reading Attenuator, 0-50 dB, 50-75 GHz **$1000.00**
HUGHES 45732H-1200 WR22 Level Set Attenuator, 0-25 dB, 33-50 GHz **$250.00**
HUGHES 45752H-1000 WR22 Direct Reading Phase Shifter, 0-360, 33-50 GHz **$1400.00**
HUGHES 45772H-1100 WR22 Thermistor Mount, -20 to +10 dBm, 33-50 GHz **$400.00**
HUGHES 47316H-1111 WR10 Tunable Detector, 75-110 GHz, pos. polarity **$600.00**
HUGHES 47741H-2310 WR28 Phase Locked Gunn Osc., 32 GHz, +18 dBm **$2000.00**
HUGHES 47742H-1210 WR22 Phase Locked Gunn Osc., 42 GHz, +18 dBm **$2750.00**
KRYTAR 201020010 Directional Detector, 1-20 GHz, SMA(f/f)/SMC **$200.00**
KRYTAR 2616S Directional Detector, 1.7-26.5 GHz, K(f/m)/SMC **$200.00**
M/A-COM 3-19-300/10 WR19 Directional Coupler, 10 dB, 40-60 GHz **$450.00**
NARDA 3000-series Octave Band Directional Couplers, N connectors **$150.00**
NARDA 3020A Bi-Directional Coupler, 50-1000 MHz **$500.00**
NARDA 3024 Bi-Directional Coupler, 20 dB, 4-8 GHz **$375.00**
NARDA 3090 Precision High Directivity Couplers **$225.00**
NARDA 368BNM Coaxial Hih Power Load, 500 Watts, 2-18 GHz, N(m) **$500.00**
NARDA 3752 Coaxial Phase Shifter, 0-180 deg./GHz, 1-5 GHz **$900.00**
NARDA 3753B Coaxial Phase Shifter, 0-55 deg./GHz, 3.5-12.4 GHz **$950.00**
NARDA 4000-series Octave Band Directional Couplers, SMA connectors **$75.00**
NARDA 4247-20 Directional Coupler, 20 dB, 6.0-26.5 GHz, 3.5mm(f) **$200.00**
NARDA 5070-series Precision Reflectometer Couplers **$300.00**
NARDA 562 DC Block, 10 MHz-12.4 GHz, 100 V max., N(m/f) **$65.00**
NARDA 765-10 10 dB Attenuator, 50 Watts, DC-5 GHz, N(m/f) **$165.00**
NARDA 791FM Variable Attenuator, 0-37 dB, 2.0-12.4 GHz **$500.00**
NARDA 792FF Variable Attenuator, 0-20 dB, 2.0-12.4 GHz **$375.00**
NARDA 793FM Direct Reading Variable Attenuator, 0-20 dB,4-8GHz **$225.00**
NARDA 794FM Direct Reading Variable Attenuator, 0-40 dB,4-8GHz **$375.00**
OMNI-SPECTRA 2085-6010-00 Crystal Detector, 1-18 GHz, neg. polarity, SMA m/f **$50.00**
PAMTECH KYG1014 WR42 Junction Circulator, 18.0-26.5 GHz **$250.00**
SONOMA SCI. 21A3 WR42 Circulator, 20 dB, 20.6-24.8 GHz **$75.00**
TEKTRONIX 2701 Step Attenuator, 0-79 dB, DC-1 GHz **$150.00**
TRG B510 WR22 Direct Reading Attenuator, 0-50 dB, 33-50 GHz **$900.00**
TRG V551 WR15 Frequency Meter, 50-75 GHz **$600.00**
TRG W510 WR10 Direct Reading Attenuator, 0-50 dB, 75-110 GHz **$1000.00**
TRG W551 WR10 Frequency Meter, 75-110 GHz **$750.00**
WAVELINE 100080 WR28 Terminated Crossguide Coupler, 30 dB **$200.00**
WEINSCHEL 150-110 Programmable Step Atten., DC-18 GHz, SMA **$450.00**
WEINSCHEL DS109 Double Stub Tuner, 1-13 GHz, N(m/f) **$150.00**
WEINSCHEL DS109LL Double Stub Tuner, 0.2-2.0 GHz, N(m/f) **$150.00**

COMMUNICATIONS

HP 37204A-003 HPIB Extender, fiber-optic connection *unused* **$250.00**
HP 4934A-J02 TIMS; CCITT option; battery power **$1650.00**
HP 59401A HPIB Bus Analyzer **$375.00**
TAMPA MW. LAB BUC1W-02W-CST Ku band Upconverter, 1 Watt 14.0-14.5 GHz WR75 *NEW* **$150.00**
TEKTRONIX 1411R-opt.04 PAL Test Gen.,w/ SPG12,TSG11.TSP11,TSG13,15,16 ..... **$1400.00**
TEKTRONIX 147A NTSC Test Signal Generator, with noise test signal **$800.00**

MISCELLANEOUS

EG&G/ P.A.R. 5302 / 5316 Lock-in Amplifier, 100 mHz-1 MHz, GPIB / RS232C **$2250.00**
FLUKE 2180A RTD Digital Thermometer **$500.00**
HP 59307A HPIB VHF Switch **$200.00**
P.A.R. 5206-95.98 Two-Phase Lock-in Amp., 2 Hz-100 kHz, GPIB **$1250.00**
TEKTRONIX TM5003 TM5000-series 3-slot Programmable Power Module **$450.00**
TEKTRONIX TM5006 TM5000-series 6-slot Programmable Power Module **$500.00**
TEKTRONIX TM503 TM500-series 3-slot Power Module **$150.00**
TEKTRONIX TM504 TM500-series 4-slot Power Module **$175.00**
TEKTRONIX TM506 TM500-series 6-slot Power Module **$250.00**
TEKTRONIX TM515 TM500-series 5-slot Portable Power Module **$250.00**

TECH FORUM

QUESTIONS

I would like to make or buy a serial to USB interface. I thought I remembered a project in *Nuts & Volts* some time ago in back issues, but don't recall the dates.

4021 Edwin
via Internet

I support a network containing analog Public Switched Telephone Network (PSTN) dial modems that are used for dial out only.

For security reasons, I need to prevent the modems from answering calls received from the PSTN network. Due to the nature of the network and type of modem, the auto answer feature cannot be disabled. I need a circuit design or commercial equivalent that will pass the analog and -48DC on-hook/off-hook components, but block the 20Hz, 80Vac ringer component of the telephone signalling.

4022 Mike Crawley
Londonderry, Northern Ireland

My wife and I work for two different airlines, both of which use proprietary terminal programs that work properly only under native DOS — not as a DOS window. Therefore, we spend about half of the time in a DOS environment and the other half in Windows 95 or 98.

In the earlier versions of DOS 6.x, the included Defrag program would allow the user to alphabetize the folders and files to easily find what you were looking for. From Windows 95 on, I haven't found the equivalent way of doing this in a native DOS environment, and a DIR command just brings up a jumble of files and folders that's tough to sort through.

How can I to do this without getting a third-party file manager? I've been told it can be done.

Also, when I minimize my Windows program, click on the DOS prompt to go to a DOS window... On my Win 95 machine, the Windows program stays minimized, the DOS C: prompt pops up, I do what I need to do in DOS, close the DOS program and type Exit, and I'm back to minimized Windows program again. If I try this on my Win 98 computer, the computer shuts down and reboots in DOS when I click on the DOS window, thereby dumping my minimized Windows program.

Is this a default settings problem on my Win 98 machine, or is there something fundamentally different between Win 95 and Win 98 in the way each handles DOS window requests?

4023 Craig Bledsoe
via Internet

My wife owns a 1998 Honda CRV. She has lost one of the transmitters to lock and unlock the doors.

The dealer wants about $100.00 to replace it. Is there a cheaper replacement or can I make one myself?

4024 Eric Funchess
via Internet

I am setting up a diskless workstation. I need a boot PROM for a NIC for a diskless node, but can't find info on this topic or where to get the PROM. Is it possible to "roll my own" boot PROM?

The application is a barebones system that I now bring up from a floppy. The disk has a self-decompressing minimal Linux system on it. I can eliminate the floppy if I boot from the network. But, if I can find a chip to act as a boot PROM with enough memory on it (EEPROM would be great) to also store the Linux system, I can eliminate the floppy, and the system could boot without a server.

Maybe there are boot applications that would not necessarily involve the NIC, and that would be fine, but I need the network to communicate with the running system anyway.

4025 Kurt Stevens
via Internet

I was wondering if it would be worthwhile to try to interface a NEC Silentwriter Model 640 laser printer to a PC?

It has an eight-pin connector (LocalTalk) and the instruction manual describes the function of the pins. I can only locate MAC software for this printer. Is this an attempt at futility?

4026 Michael Taylor
via Internet

What type of DC motor and controller could be used to obtain a smooth non-cogging slow rotation down to 3 RPM — direct drive?

Is there anyone (on the side, reasonably priced) who might do custom work involving a linear lathe and motor control?

I'm trying to reproduce a simple overhead record mastering

This is a READER TO READER Column. All questions AND answers will be provided by Nuts & Volts readers and are intended to promote the exchange of ideas and provide assistance for solving problems of a technical nature. All questions submitted are subject to editing and will be published on a space available basis if deemed suitable to the publisher. All answers are submitted by readers and NO GUARANTEES WHATSOEVER are made by the publisher. The implementation of any answer printed in this column may require varying degrees of technical experience and should only be attempted by qualified individuals. Always use common sense and good judgement!

Send all material to *Nuts & Volts Magazine*, 430 Princeland Court, Corona, CA 92879, OR fax to (909) 371-3052, OR email to forum@nutsvolts.com

ANSWER INFO

- Include the question number that appears directly below the question you are responding to.
- Payment of $25.00 will be sent if your answer is printed. Be sure to include your mailing address if responding by email or we can not send payment.
- Your name, city, and state, will be printed in the magazine, unless you notify us otherwise. If you want your email address printed also, indicate to that effect.
- The question number and a short summary of the original question will be printed above the answer.
- Unanswered questions from a past issue may still be responded to.
- Comments regarding answers printed in this column may be printed in the Reader Feedback section if space allows.

QUESTION INFO

To be considered

All questions should relate to one or more of the following:

1) Circuit Design
2) Electronic Theory
3) Problem Solving
4) Other Similar Topics

Information/Restrictions

- No questions will be accepted that offer equipment for sale or equipment wanted to buy.
- Selected questions will be printed one time on a space available basis.
- Questions may be subject to editing.

Helpful Hints

- Be brief but include all pertinent information. If no one knows what you're asking, you won't get any response (and we probably won't print it either).
- Write legibly (or type). If we can't read it, we'll throw it away.
- Include your Name, Address, Phone Number, and email. Only your name, city, and state will be published with the question, but we may need to contact you.

lathe and I do have one to help us.
4027 Kim
via Internet

I have recently purchased a semi-remote 20 acre parcel overlooking a lake, that I frequent about twice a month.

Being a former goldmine, it has a cabin and several buildings on it, but no electricity or phone line. The closest phone terminal is about one-two miles away. My problem is securing the property.

My plans are to attain dialtone and, through an alarm hooked to an autodialer, keep the premises secure. Line extension from the phone company will run into thousands of dollars.

Is there a way to use RF (i.e., mobile radio, ham, gmrs, frs) to interface to a telephone to give my property dialtone? I know there are repeaters in the 400+ MHz range, but, they are outside my budget. Any suggestions?

Power is not a problem. I have solar panels, batteries, inverters, etc. I am also into electronics.
4028 Sean Miller
via Internet

I have a Teac AG-D8900 AV digital home theater receiver.

Everything works great, except I inadvertently programmed one AM station into memory scan four times and an FM station in three times.

When I use the remote scan, it stops four times on AM and three times on the FM band, what a pain.

I need to erase the extra stations from memory and leave the area blank like it was originally.

Teac never acknowledged my letters.

How do I erase a programmed channel from memory scan, other than adding another frequency in its place?
4029 Anonymous

I am looking to build a simple VGA-to-TV composite video converter. I need it to work in DOS only and be able to convert plain (25 lines) monochrome text only. I am aware of commercial units for $100.00+.
40210 Haim Sandel
via Internet

ANSWERS

[3023 - MAR. 2002]

I've admired radio clocks for a while. I plan to make a PIC clock next. Is there a chip I can integrate in for self-setting time?

There does not appear to be a one-chip solution to receiving the time signal you refer to. This URL: **www.solutions-cubed.com/Stamp/july99.pdf** will take you to a six-page PDF file that is a paper describing a BASIC Stamp2 project similar to the one you envision.

The paper includes a schematic that is described as having been published in the July '99 issue of *Nuts & Volts*.

The schematic includes receiver and decoder modules from a company called ULTRALINK. The paper's author is from ULTRALINK. This URL **www.ulio.com** is the ULTRALINK home page. There is no pricing information there, but there is an email link that would let you ask.

Another site with a lot of information about projects like yours is **www.cl.cam.ac.uk/~mgk25/lf-clocks.html**. The trick to finding all this information and more is to search for the common name of the signal source you are interested in. For example, for receivers that work in the US, a search for "WWVB receiver" will have you hip deep in links. For receivers that work in the U.K. a search for "Rugby MSF Receiver Modules" will yield an overwhelming number of pages. One interesting one is **www.maplin.co.uk/**. This site offers a module of the sort your interested in for receiving a U.K. time signal.
Tom Tillander
Bay Village, OH

[2026 - FEB. 2002]

I have a US Army Signal Corp., radio receiver and transmitter set that needs batteries, to get the set in operation. The P/N for the batteries are B-A-38-"B" and B-A-37-"B" battery.

I need information on how I can get the Army manual (TM-11-235), and batteries.

#1 The radio you are referring to is probably the BC-611 "handy talkie." It would operate from 3.5-6 MHz AM with an output of around 35 milliwatts.

The 611 used a 1.5 volt BA-37 filament battery, and a 103.5 volt BA-38 for the plates on the tubes. According to military nomenclature, the BC-611 is the radio itself. The SCR-536 is the complete unit including batteries.

You can find a schematic at: **http://hereford.ampr.org/mil-list/sch/bc-611.gif**

If you want to get a copy of TM11-235, check out Military info.com: **www.military-info.com/mphoto/new1j01.htm**

You will also find neat info on the 611 at: **www.pacificsites.com/~brooke/BC611.shtml**
Phil Shewmaker
Louisville, KY

#2 You can get the manual and much more at **www.military-media.com/master.html**. The CD contents are at: **www.military-media. com/radio.html**.

Instead of the original batteries, which will be expensive, I suggest a commonly available battery and DC-to-DC converter.
Russell Kincaid
Milford, NH

[3024 - MAR. 2002]

Does someone have a good schematic and parts list of a PC-based stepper motor controller that a beginner could build for a three-axis controller? Or a kit?

It looks like Robert Nansel wrote an article addressing your question in the same issue your question was printed in! Look at the Amateur Robotics column on page 59 of the Mar. '02 issue for a schematic of a three-axis controller. Apparently they're also being sold.

I built a very simple single stepper controller about six years ago. It was merely a bunch of transistors with their bases connected through a 4.7k resistor to the data bits of my parallel port. I programmed it using QBASIC using a simple loop sending four (?) bytes, corresponding to the pins which needed to be activated, to the port then repeating.

The motors were very weak. I'm unsure if this was due to my circuit, my programming, or the

Professional

Factory Direct
10 HOUR RECORDER
"BUILT LIKE A BATTLESHIP"
• Heavy duty commercial recorder — NOT improvised from consumer models
• 12, 14, and 16 hour models also available
• BUILT-IN voice activation (add $30)
• Applications information included
• Dimensions: 11.5 x 7.0 x 2.75"
SPECIAL Nuts&Volts Price .. $159
FREE 40-PAGE SPECIAL EQUIPMENT CATALOG!
COD's OK. Sorry, no credit cards. Free catalog USA only; other countries $5. Price Includes UPS to 48 States on Pre-Paid Orders
Viking Systems International 100 North Hill Drive #42, Brisbane, CA 94005
Phone (415) 467-1220 • Fax: (415) 467-1221 • Web: www.vikingint.com
Circle #45 on the Reader Service Card.

Real-world connectors!
Tired of those .1 inch headers? Try our products with easy to use screw terminal block connectors.
Power supply, cable, and software included with most products - no hidden charges for "accessories"!
Stop by our web site to see our entire line of products, including the complete reference manuals.
TC51 SBC $129 Atmel 89C4051, serial EEPROM, two 12 bit A/D, four digital I/O, high current relays, plus Tiny Machine Basic with LCD support - a complete control system for the price of an SBC.
T51 SBC $49 Atmel 89C2051, 9 digital I/O, Tiny Machine Basic, serial EEPROM, plus T51 family plug-in boards.
SBC-1 $199 Intel 80C51, EEPROM, A/D, RAM, RTC, 50 digital I/O, industrial I/O connectors.
RS51-SPR $49 addressable and chainable high current RS-232 relay.
INDUSTROLOGIC®
3201 Highgate St. Charles, MO 63301 USA
(636) 723- 4000 (800) 435-1975
www.industrologic.com
Circle #46 on the Reader Service Card.

TECH FORUM

[2022 - FEB. 2002]

I want to build an electronic (LCD) weight scale. I would like to measure pressure caused by certain stresses anywhere from 1lb to 1000lbs. I was thinking piezo electric material for the voltage transducer and then amplified.

#1 The National Semiconductor website has an application note (#AN301) that has a circuit for a weighing system using a strain gauge.

The strain gauge is a resistive bridge which is unbalanced by strain. You glue it to a bendable beam which indicates the weight by the amount of bending. You can view the app note at: **www.national.com/an/AN/AN-301.pdf**. Another weighing system is at: **www.national.com/an/AN/AN-295.pdf**.

Russell Kincaid
Milford, NH

#2 I have dealt with exactly this problem!

The best "quick-start" reference is definitely OMEGA's free manual/catalog The Pressure and Force Handbook (at **OMEGA.COM**). It's a great source for learning the basics about instrumentation.

The allowable load range is rather large, so you may find it more economical to break it into two ranges. For the 0 to 40 pound range, you may want to use their LCL-040 ($69.00).

You DO NOT want to use piezoelectric sensors! They only measure changes in load. If you were to step on a piezo, it would only emit a signal as you were stepping on it (applying the load), but nothing afterwards (simply resting the load on it).

Thomas Ng
San Jose, CA

#3 The easiest way to accomplish this is through a strain gauge measurement in a bridge arrangement. Use a metal piece with eyelets and a suitable cross section (you need to stay in the linear region of the material, but get the stresses up to get a useable signal) and glue strain gauges perpendicular to each other on this piece with the recommended adhesive. Hook the four connections up to bridge excitation and signal conditioning (Linear Technology and Signetics have a few application notes on this, check their websites).

The output is typically 0-10 volts and can be connected to a digital panelmeter.

You can get ready-made load-cells for industrial applications, but they are pricey and have 0 or 4-20 mA outputs or use other digital interfaces.

Walter J. Heissenberger
Hancock, NH

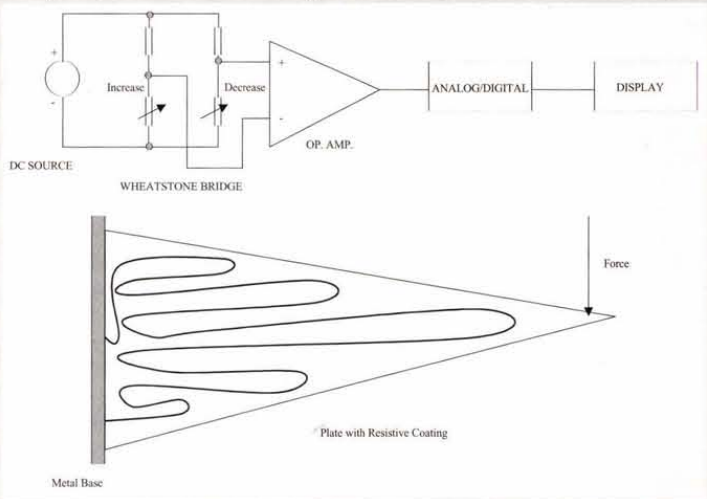
#4 The weight scale you just took apart is using a resistive sensor and a Wheatstone bridge to measure how much the plate is bending because of the weight.

The small plate is covered on both sides with a resistive material. Once the weight is bending the plate, one resistor is elongated and one is shortened. This causes the resistance to change and the bridge looses the equilibrium. The resulted voltage is usually applied to a O.A. and then to a A/D to be converted and displayed. The IC from the control board is quite complex and if you try to reproduce the function with normal ICs, it's not so simple, so it will be a good idea to reuse that IC.

A mechanical fixture adapted to the new weight range is a good and simple solution.

See figure below.

Radu Constantinescu
Falls Church, VA



motors themselves.

If you're interested in this overly-simple approach feel free to email me.

Eric Hungerford
Seattle, WA
finatronics@yahoo.com

[12015 - DEC. 2001]

I purchased a kit from Parallax, to program the Scenix SX28AC/DP microcontroller.

I want to use the b pins as wake-up inputs and I can't figure out how.

Could someone submit a program that would react to a push button on b1 by turning on an LED at a1, or a push button at b2 by turning on an LED at a2, and going to sleep after either case, only to wake up and react again to either of those buttons being pushed?

The source file, sxMIWU.src (Available at **www.nutsvolts.com**), shows how to use the sleep and wakeup interrupts on the Scenix SX28 chip. By changing the constant in the line "MOV !rb,#%11110100 ; port B[7:4,2] to normal..." you can select which of the four switches wake up the processor.

The documentation indicates that an interrupt at location 0 is executed, but my testing indicates that it performs a reset when a button is pressed. The code has been modified accordingly. The SXkey debugger is particularly weak in monitoring interrupt routines, but free running seemed to produce similar results!

Barry
Camas, WA

Continued on page 56

Circle #47 on the Reader Service Card.

Mr. NiCd **SPRING SPECIALS!** THE BEST BATTERIES IN AMERICA!

Packs & Charger for YAESU FT-50R / 40R / 10R:

FNB-40xh Slim-NiMH	7.2v	650mAh	$41.95
FNB-47xh (NiMH)	7.2v	1800mAh	$49.95
FNB-41xh (5w NiMH)	9.6v	1000mAh	$49.95

For YAESU FT-51R / 41R / 11R:

FNB-38 pack (5W)	9.6v	700mAh	$39.95

For YAESU FT-530 / 416 / 816 / 76 / 26:

FNB-26 pack (NiMH)	7.2v	1500mAh	$32.95
FNB-27s (5w NiMH)	12.0v	1000mAh	$45.95

For YAESU FT-411 / 470 / 73 / 33 / 23:

FNB-11 pack (5w)	12.0v	600mAh	$24.95
FBA-10 6-Cell AA case			$14.95

Packs for ALINCO DJ-580 / 582 / 180 radios:

EBP-20ns pack	7.2v	1500mAh	$29.95
EBP-22nh pk (5w)	12.0v	1000mAh	$36.95
EDH-11 6-Cell AA case			$14.95

For ICOM IC-Z1A / T22-42A / W31- 32A / T7A:

BP-180xh pk (NiMH)	7.2v	1000mAh	$39.95
BP-173 pack (5w)	9.6v	700mAh	$49.95

For ICOM IC-W21A / 2GXAT / V21AT:(Black or Gray)

BP-132s (5w NiMH)	12.0v	1500mAh	$49.95

For ICOM IC-2SAT / W2A / 3SAT / 4SAT etc:

BP-83 pack	7.2v	600mAh	$23.95

For ICOM 02AT etc & Radio Shack HTX-202 / 404:

BP-8h pack	8.4v	1400mAh	$32.95
BP-202s pack (HTX-202)	7.2v	1400mAh	$29.95

For KENWOOD TH-79A / 42A / 22A:

PB-32xh pack (NiMH)	6.0v	1000mAh	$29.95
PB-34xh pack (5w NiMH)	9.6v	1000mAh	$39.95

For KENWOOD TH-78 / 48 / 28 / 27:

PB-13 (original size!)	7.2v	700mAh	$26.95

For KENWOOD TH-77, 75, 55, 46, 45, 26, 25:

PB-6x (NiMH, w/chg plug!)	7.2v	1200mAh	$34.95

Mail, phone, & Fax orders welcome! Pay with Mastercard / VISA / DISCOVER / American Express
Call 608-831-3443 / Fax 608-831-1082
Mr. NiCd - *E. H. Yost & Company*
2211-D Parview Road, Middleton, WI 53562
CALL OR WRITE FOR OUR FREE CATALOG!
Cellular / Laptop / Videocam / Commercial & Aviation packs too!
E-mail: ehyost@midplains.net

WWW.POLARISUSA.COM **OVER 700 DIFFERENT PRODUCTS IN STOCK!!!** 800-308-6456

LIPSTICK CAMERAS • DIGITAL RECORDERS • **CALL OR CHECK ON-LINE TO ORDER YOUR FREE COLOR VIDEO CATALOG** • MICRO CAMERAS • WIRELESS VIDEO

1/3" COLOR OUTDOOR CAMERA

This camera merges the gap between bullet or lipstick cameras and full-size housings with cameras. Unlike bullet or lipstick cameras with limited features, this unit has many features only found on larger, cased cameras. The AV-48WC8 keeps the best part of the bullet/lipstick line in that they install quickly and come pre-assembled, ready for installation. Auto iris and vari-focal lens options are available upon request.
We have 6 different configurations to meet your requirements for outdoor or indoor

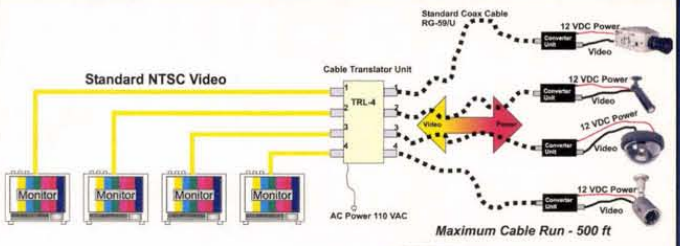
6 Configurations

- B/W: Regular, Auto Iris, Vari-Focal Lens
- Color: Regular, Auto Iris, Vari-Focal Lens

AV-48WC8 - $235.95

Industrial "O" Ring Sealed Aluminum Case

CABLE TRANSLATOR



Maximum Cable Run - 500 ft

TRL-4 This fantastic cable translator provides DC power through your existing coax cable to supply power to cameras. At the same time, and via the same cable, the video signal is received and relayed to a monitor. With four input/output connectors, this translator is very simple to install.

TRL-4 $189.95

Converters Are Included

HIGH GAIN DIRECTIONAL PATCH ANTENNAS

The Patch or Panel Antenna elements are temperature stable with a low return loss and low frequency drift vs. temperature.
They offer heavy duty use, yet are lightweight construction.
Maximum wind survival speed of 180 km/h is achieved by use of a solid aluminum mounting back (DA-12, DA-18) High gain signal feature is guaranteed by the excellent VSWR specification of 1.5dB.

DA-6 - $29.95

DA-12 - $119.95

Visit our website for more information

USB VIDEO CONVERTER

USB-01 $89.95

USB-01 The **USB Video Converter** acts as an interface for your analog video sources and converts analog output to digital for your computer. The **USB Video Converter** accepts high resolution SVHS video and standard composite NTSC video.

Other features include:

- High Speed
- Snap Shot
- Editing Capabilities
- Compact & Portable
- Compression Capabilities
- Two Video Inputs
- Plug-N-Play
- Independent Power Source

Call today for more information.

DIGITAL MONITORING & RECORDING SYSTEM
"YOUR WEB BROWSER IS YOUR REMOTE EYE!"

The **PV-140 Series** turn your own PC into a commercial grade digital security system in a few minutes. The **PV-140 Series** integrates a color quad processor, multiple zone video motion detector, multiplexer, and a real time digital video recorder (DVR).

PV - 140-A - $299.95

- ✓ **TCP/IP**
- ✓ **MODEM**
- ✓ **LAN/WAN**

Each card can connect up to 4 cameras.

Works Great With Our Wireless Receivers, Too!

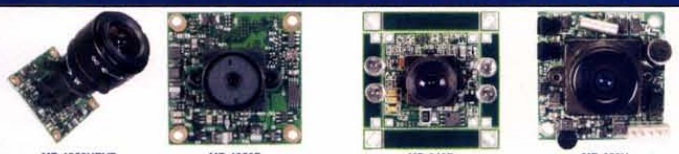
GFR-2400 - 2.4GHz Receiver - $149.95

Whether using this indoors or outdoors, the benefits of this compact, discreet miniature color camera are extraordinary. The infrared LEDs make it excellent for video recording in low light situations up to a distance of 10 meters (32.8 feet). The weatherproof anodized aluminum housing and adjustable brackets for wall or ceiling mounts make this an ideal camera in a variety of applications.

ILC-300 - $189.95

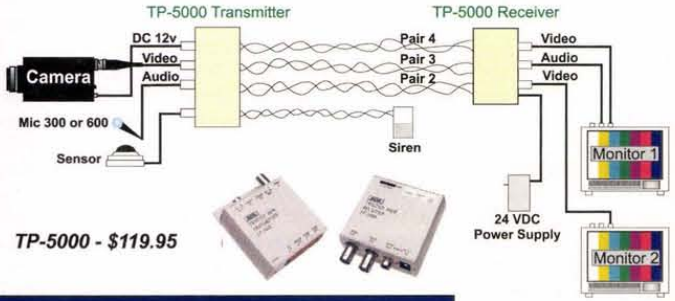
Call Today for more Information

MICRO BOARD CAMERAS MANY MODELS TO CHOOSE FROM!



MB-1250HRVF Color Varifocal	MB-1250P Color Pinhole	MB-810B Infrared B/W	MB-650U B/W Audio
$169.95	***$89.95***	***$69.95***	***$39.95***

LONG DISTANCE TWISTED-PAIR AV TRANSMISSION SYSTEM



TP-5000 - $119.95

- Use Category-5 Twisted-pair Wire, Easy And Fast To Install
- Selectable 6-zone Transmission Range, Up To 1.2 Km
- Will Power Most (12vdc) Cameras, No Need For External Power At Camera Location (200m Max.)
- System Is Ready To Accept PIR Sensors Or Alarm Inputs
- Video And Audio Transmitted With Clarity And Immune From Noisy Electrical Environments

Call today for more information.

MICRO AUDIO RECEIVER

We offer two models of audio receivers or microphones. Surface mount technology and the latest in MOSFET audio amps are used in the design. Automatic Gain Control (AGC) and Dynamic Level Control (DLC) are employed to assure every sound will be picked-up while not overwhelming other sounds.

MIC-300 - $14.95

5" COLOR WIRELESS OBSERVATION SYSTEM

ADD UP TO 3 ADDITIONAL CAMERAS!

Now you can enjoy peace of mind with our new wireless observation system. Comes with a 5" wireless color monitor, a wireless color camera. Just Plug-&-Play for perfect wireless video any time! Great for around the house, office or technical field work .

GW-2400SA - $379.95

12 VOLT RECHARGEABLE BATTERY PACK

NOW YOU CAN OPERATE YOUR CAMERA OR TFT MONITOR IN THE FIELD!

RBP-12V - $69.95

There's no need to wait until your battery pack is fully discharged, you can re-charge at any time!
This 12V high-capacity portable, rechargeable battery pack will operate any of our 12V cameras, transmitters and TFT Monitors. It has a charge time of 4 hours and allows for a total of 2000 re-charges.

800-308-6456

Tech 404-872-0722 • Fax 404-872-1038

WWW.POLARISUSA.COM

POLARIS INDUSTRIES

470 Armour Drive NE • Atlanta GA 30324-3943

Handheld Radio with Built-in GPS

By Gordon West

The long overdue handheld two-way radios with built-in GPS and maps are here ...

It was long overdue — a handheld two-way radio with built-in Global Positioning System and maps. Ham radio manufacturer Kenwood Corporation has proved that the utility of portable GPS automatic sending-of-position is a valuable tool over the airwaves. Thousands of hams have the Kenwood D7 amateur radio handheld, coupled with a little jumper cable to almost any type of GPS receiver that would output the NMEA datastream. Amateur radio operators will then tie in this signaling technology to the Automatic Packet Reporting System (APRS), allowing other operators around the world to see the position of the equipment as long as there is a host download station nearby that takes the packets and puts them onto a website. The system works great!

But the Kenwood D7 portable ham radio handheld with the accompanying Global Positioning System receiver was a bit bulky in light of micro-GPS capabilities. After all, GPS receivers may now be constructed within the innards of a wristwatch, so why not take this micro-GPS technology and build it into a simple two-way radio portable transceiver?

A couple of years ago, Garmin USA previewed a prototype cellular phone with a built-in GPS. This product never really got off the ground, and unfortunately, it was several years well ahead of its time. NOW, under FCC order for enhanced 911 service, many new portable cellular phones now incorporate GPS capabilities so emergency dispatchers may easily see the GPS position displayed on their dispatch center screen. While the E911 program with GPS positioning is still in its infancy, the capabilities of a single two-way radio with position-finding capabilities is thought to be a big breakthrough. But why won't a manufacturer give us a simple little handheld that could be used for license-free communications and also automatically transmit location information to another handheld with the same built-in GPS circuitry? Out hiking, Mom calls the kids and asks, "How far ahead are you on the trail?" Back comes the answer, and Mom looks down at the display and sees that she better pick up the pace because the kids are almost a mile ahead.

FIRST EVER CONSUMER GPS HANDHELD

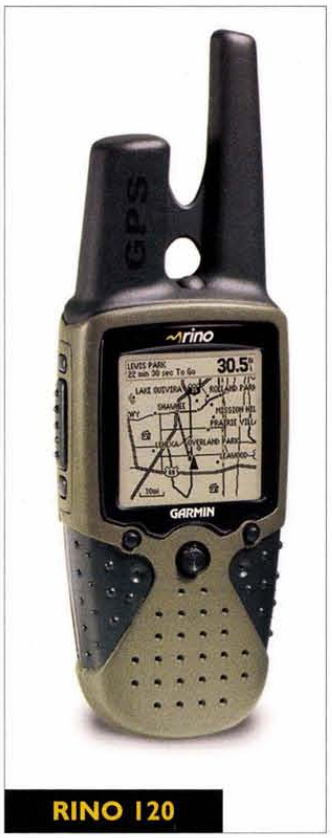
Garmin USA — a leader in marine electronics and GPS technology — announced the first-ever consumer electronics GPS positioning UHF handheld, surprisingly signaling both voice and data over the common Family Radio Service 14 channels, as well as capabilities on their step-up model for longer range General Mobile Radio Service (GMRS) repeater and simplex operation. What was truly amazing about this all-in-one transceiver was its affordable price (under $170.00 each) and capabilities to not only send voice and data on the common FRS channels, plus voice on GMRS, and also stay working even after submersion in case the canoe turns turtle.

"Federal Communications Commission rules would need to be amended to authorize Family Radio Service (FRS) units to transmit an additional emission type, and to revise the permissible communications rule that applies to FRS units," comments Dan Bartel, Director of Recreational & Consumer Electronic Sales at Garmin. In its petition, Garmin proposed to allow FRS units to transmit GPS location information using emission type F2D in a digital data burst of not more than one second.

After they sent in their proposal to the FCC, there were several months for users and other radio companies to either agree with their petition or to try to block their path for a rule waiver. From what I understand, there was very little opposition, and Garmin was ultimately given the green light by the FCC to begin marketing this new concept in communications.

"We believe the record in this proceeding warrants proposing amendment ... of our rules because we (the FCC) believe that the proposed amendments will benefit FRS users," comments the FCC in their discussion of the petition in a released statement on December 20, 2001.

"Specifying only one emission type in Section 95.631(d) may have unintentionally limited some manufacturer's capability to develop FRS units that could be even more useful to the public ... we agree with Garmin that limiting



RINO 120

RINO 110

FRS units to transmitting a digital data emission for no more than one second out of a 10-second period and requiring that a digital data transmission be initiated manually by the FRS user appear to be, in combination, a reasonable method of minimizing interference between data communications and voice communications on FRS channels," adds the FCC.

The new Garmin FRS/GPS radio is nicknamed "Rino," partly because the twin antennas look a little bit like the head of a Rhinoceros, and a not necessarily so easily understood acronym on how this new radio works. I would have called it something like "COMM NAV" or simply "Radio Locator." But nonetheless, both the Rino 110 and Rino 120 support 22 communication channels, where you may select CTCSS, as well as add voice scrambling for your operation on FRS and GMRS frequencies. Keep in mind that GMRS operation requires a license. FRS does not. The Garmin radios feature 12-channel GPS with Wide Area Augmentation System (WAAS) differential correcting reception. Instead of getting down to the radius of a 30-foot circle, most Garmin WAAS-enabled receivers get you down to about a six-foot circle!

The less expensive Rino 110 has a graphic plotter screen for mapping of user waypoints and points of interest. The more expensive Rino 120 includes 8 MB of internal memory and the addition of a built-in base map of North and South America. Map detail includes cities, highways, thoroughfares, and secondary roads within metro areas. With the 8 MB downloaded, you can get all the way down to topographic, bathymetric, and street level detail via Map Source™ data from Garmin who does their own sea and land cartography in house. The Rino 120, priced at around $250.00 each, adds more mapping capabilities including running Garmin exceptionally clear and clean marine charts. This means the step-up model may be used for both boating, as well

Two Step Tuning

Step One: Pick up microphone.
Step Two: Transmit.
(Please note: HF Tuning doesn't get much easier than this.)

SGC Smartuner™

HF Automatic Antenna Couplers

"For me and my radio dollar, there isn't a better coupler made!"
Jack Huebschen N9XRO

Power Input: From 1.5W - Up to 500W*
HF Frequency Range: From 1MHz - Up to 60MHz*
Up to 4,000,000 element combinations*
Five Sensor Devices *Specs differ per model

"Undoubtedly the best piece of hamgear I have ever owned."
Ronnie Kane K9MNI

Marine, Commercial, Amateur Radio, Aviation, Special Applications

Starting at $249

SGC

MADE IN USA

www.sgcworld.com

Toll Free (800) 259-7331 • Tel (425) 746-6310 • Fax (425) 746-6384 • Email: sgc@sgcworld.com

Mailing: PO Box 3526, Bellevue, WA 98009 • Shipping: 13737 SE 26th St. Bellevue, WA 98005 USA

Circle #74 on the Reader Service Card.

Copyright 2001 SGC, Inc.

2539 W. 237th St. Bldg. F, Torrance, CA 90505
Order desk only: USA: (800) 872-8878 CA: (800) 223-9977
LA & Technical Info: (310) 784-5485
Fax: (310) 784-7590

TIMELINE INC.

Over 16 years and 33,000 customers and still growing
email : mraa@earthlinknet •http://www.digisys.net/timeline

Minimum Order: $20.00. Minimum shipping and handling charge $5.00. We accept cashier's checks, MC or VISA. No personal checks or COD's. CA residents add 8.25% sales tax. We are not responsible for typographical errors. All merchandise subject to prior sale. Phone orders welcome. Foreign orders require special handling. Prices subject to change without notice. 20% restocking fee for returned orders.

LIQUID CRYSTAL DISPLAYS

240x64 dot LCD with built-in controller
AND 4021ST-EO. *Unit is EL back-lit.* *$29.00 or2 for $49.00* or
OPTREX. DMF5005 *(non back-lit)* *$29.00 or2 for $49.00*
20 character x 8 line 7¹/8L x 2½H
The built-in controller allows you to do text and graphics

240x128 LCD *with built-in controller* *$29.00 2 for 49.00*
256x128 LCD *with built-in controller* *$29.00 2 for 49.00*

Alphanumeric-parallel interface

16x1	$5.00	20x2	$6.00	32x2	$5.00
16x1 (lg. char.)	$7.00	20x4	$8.00	40x1	$5.00
16x2	$5.00	20x4 (lg. char.)	$10.00	40x2	$7.00
16x2 (lg. char)	$10.00	24x2	$6.00	40x4	$15.00
16x4	$8.00	32x4	$5.00	4x2	$4.00

5Vpower required · Built-in C-MOS LCD driver & controller
· Easy "microprocessor" interface · 98 ASCII character generator
Certain models are backlit, call for more info

Graphics and alphanumeric – serial interface

size	Mfr.	price	size	Mfr.	price
640x480 (backlit)	Epson	$15.00	320x240	Epson	$15.00
640x400 (backlit)	Panasonic	$10.00	256x128	Epson	$15.00
640x200	Toshiba	$10.00	240x128 (backlit)	Optrex	$15.00
480x128 (backlit)	ALPS	$8.00	240x64	Epson	$15.00
480x128	Hitachi	$6.00	160x128	Optrex	$15.00

6" VGA LCD 640x480,
Sanyo LMDK55-22 **$15.00**

MONITORS

NON-ENCLOSED TTL
Comes with pinout. 12v of 1.4 input •Horizontal frequency 15Khz
•Ability to do 40 and 80 column.
5 inch amber $15.00 • 7 inch amber $19.00 • 9 inch amber or green $19.00

5" COLOR MONITOR $19.00 *2 FOR $29.00*
• Flat Faceplate • 320 x 200 Dot Resolution • CGA & Hercules Compatible
• 12 VDC Operation • 15.75 KHz Horiz. Freq. • 60 Hz Vert. Sync. Freq.
• Open Frame Construction • Standard Interface Connector
• Degaussing Coil included • Mfr. Samtron

HACKER CORNER

57 WATT UPS SUPPLY $19.00
(COMES w/ 12V @ 2.2AMP BATTERY)
Unit designed to provide uninterrupted DC power in the event of loss of the primary 110 / 220 VAC supply. It utilized a 12 V sealed lead acid battery as a source of power until the AC supply can be restored. It is a versatile unit which can be used in a number of different applications. The outputs are +5 VDC @ 6.5A, + 3.6 VDC @ 2.5A, + 12 VDC @ 8A, - 12 VDC @ .5A, and a battery charging output of 12 VDC @ 10A. The DC outputs are terminated in the in-line connectors which interface with standard motherboard and drive connectors. Possible applications include: Robotics, scientific sensing and recording, Linux devices attached to Ethernet or Internet links, etc...
• The unit is small enough (2" x 3.5" x 8.5") to be contained in a standard PC enclosure, in place of the regular power supply – interfacing directly with the motherboard – providing an uninterruptible power supply • It can function as a DC - DC power supply finishing multiple outputs using a 12 VDC Input
• The 10 Amp, 2 VDC output can be used as a battery charger with any AC input from 100-240 V • The unit is a versatile 57 watt DC power supply providing +5 and 3.6 VDC as well as +/- 12 VDC.

EMBEDDED 486 COMPUTER $59.00
2 FOR $109.00
Complete enhanced Intel 486SX-33 based computer in ultra small (9-7/8L x 6-5/8W x 3-1/8H) case. Ideal for embedded operations or as a second computer. Features include: • 3 serial ports plus dedicated printer port • Parallel optical coupled adapter port • Built in IBM PC/AT keyboard port • On board VGA video and port • Uses standard SIMM up to 32 MB • BIOS is PC/AT compatible Unit has a backup Ni-Cd battery system in case of power failure (5 min. backup time) and lockable front cover to prevent floppy drive access. Mounting/interface provisions for standard 3.5" laptop floppy and 2.5 inch hard drives. Comes with very comprehensive manual. Ultra small (9-7/8L x 6-5/8W x 3-1/8H) case.

CELL SITE TRANSCEIVER $19.00 2 FOR $29.00
These transceivers were designed for operations in an AMPS (Advanced Mobile Phone Service) cell site. The 20 MHz bandwidth of the transceiver allows it to operate on all 666 channels allocated. The transmit channels are 870.030-889.980 MHz with the receive channels 45MHz below those frequencies. A digital synthesizer is utilized to generate the selected frequency. Each unit contains two independent receivers to demodulate voice and data with a Receive Signal Strength Indicator (RSSI) circuit to select the one with the best signal strength. The transmitter provides a 1.5 watt modulated signal to drive an external power amplifier. Channel selection is accomplished with a 10-bit binary input via a connector on the back panel. Other interface requirements for operation are 26 VDC (unregulated) and an 18.990 MHz reference frequency for the digital synthesizer. The units contain independent boards for receivers, exciter, synthesizer, tunable front-end and interface assembly (which includes power supplies and voltage-controlled oscillator) Schematics and circuit descriptions included

Circle #75 on the Reader Service Card.

EPROM+

A device programming system complete info at www.arlabs.com

✦ *EXCEPTIONAL POWER FOR THE PRO*
✦ *EASY-TO-USE FOR THE NOVICE*

Here's what you get: A rugged, portable programming unit including the power pack and printer port cable both of which store inside the case. A real printed user and technical manual which includes schematic diagrams for the programming unit plus diagrams for all technology family adapters*. Comprehensive, easy-to-use software which is specifically designed to run under Windows 95, 98, ME and DOS on any speed machine. The software has features which let you **READ**, **PROGRAM**, **COPY** and **COMPARE** plus much more. You have full access to your system's disk including **LOADING** and **SAVING** chip data plus automatic processing of **INTEL HEX**, **MOTOROLA S-RECORD** and **BINARY** files. For detailed work the system software provides a full screen buffer editor including a comprehensive bit and byte tool kit with more than 20 functions.

Broad device support: Including **FIRST GENERATION EPROMS** (2708, TMS2716*, 25XX etc.) **SECOND GENERATION EPROMS** (2716-27C080)(8 MEG), **40 and 42 PIN EPROMS*** (27C1024-27C322)(32 MEG) **EEPROMS** (2816-28C010) PLUS **ER5901**, **FLASH EPROMS** (28F,29C,29EE,29F)(32 MEG), **NVRAMS** (12,20,X2210/12) **8 PIN SERIAL EEPROMS*** (24 ,25 ,85, 93, 95, 80011A) PLUS **ER1400/M58657*** **BIPOLAR PROMS*** (74S/82S), **SERIAL FPGA CONFIGURATORS** (17CXXX) **MICROS*** (874X,875X,87C5X,87C75X,89C) **ATMEL MICROS***(89S,90S)(AVR) **PIC MICROS*** 8, 18, 28, 40 PIN (12CXXX,16C5X,6X,7X,8X PLUS FLASH & 17C) **MOTOROLA MICROS*** (68705P3/U3/R3, 68HC705C8/C9/J2/P9, 68HC11 all families)

$289

In cludes step-by-step tutorial plus explanation of EPROM fundamentals
1 YE AR WARRANTY - 30 DAY MONEY BACK GUARANTEE
*REQUIRES SNAP-IN ADAPTER (ORDER FACTORY DIRECT OR BUILD YOURSELF)

$7.00 SHIPPING ⋄ $6.00 C.O.D.
VISA ● MASTERCARD ● AMEX

ANDROMEDA RESEARCH, P.O. BOX 222, MILFORD, OHIO 45150
(513) 831-9708 FAX (513) 831-7562
website - www.arlabs.com email - arlabs@worldnet.att.net MADE IN THE U.S.A.

as on the roads.

HOW DOES IT WORK?

So, the way it works is you are communicating with another similar Rino unit from Garmin, and the other stations asks you where you are located. You look around and all you see are trees and hills. Manually activate the GPS data send function, and presto, the other station will now see how far away you are, magnetic bearing to you, and could even pull up your position on their own local map. And if you want to know where THEY are, ask them to send you THEIR position — and within just a couple of seconds, your little Family Radio Service does the number crunching and you see their distance and magnetic bearing on YOUR screen. And according to Pete Brumbaugh — the Garmin media man and in-the-know about all of Garmin products — the final version of the Rino 110 and 120 will probably get into the hands of frequent radio users with capabilities to play with configurable maps from Garmin to make the equipment exactly the way that everyone wants it to be on the airwaves, and for location position gathering. Pete says that the waiting time for a sample unit is over a few months, and they are having way too much fun themselves playing with all the bells and whistles that this equipment may offer.

Certainly, safety is a big issue in what this new GPS-based transceiver could do in an emergency. If the kids, out on the trail, trip over a rock and slide down a hill, you would ask them to send their location, and presto, you would be able to get to their location down to the radius of that six-foot circle. "Rino stands for Radios Integrated with Navigation for the Outdoors," comments Brumbaugh. "Step-up model 120 may offer a plethora of accessories including a VOX headset, vibration alert, voice scrambler, call ring function, and all of the capabilities to upload Garmin cartography," adds Brumbaugh, proudly showing off the new Rino and its unique capability to send and receive other Rino positions.

But keep in mind that the way GPS works is through the process of triangulation to more than four satellites within view. Inside a shopping mall, there will be no satellites in view. So don't expect that the GPS function will work anywhere other than with a clear shot at the sky. Sure, in another 10 years, I expect to see GPS signal extenders inside shopping malls, as well as inside big factories to control robotics, but for now, the other station needs to be in view of the satellites in order to derive their GPS position fix.

WHAT'S NEXT?

Garmin also indicates that it may soon put together a program with Timex — the watch people — and this will add one more wristwatch GPS system out there tuning into the 1575 MHz satellite airwaves. The new Garmin FRS/GMRS handhelds have plenty to offer, including safety. The technology is certainly here to incorporate the Garmin GPS receiver inside any one of their many models of two-way radios. Garmin went to great efforts to convince the FCC to look over their petition on a better use for those 14 FRS channels in addition to voice, and for the next couple of years, Garmin will prove that this technology is indeed practical, affordable, and my guess, lifesaving. Look for the new Garmin radio/GPS handheld transceivers to hit the market around summertime, and let's see where they go with this new communication and radio GPS location technology. Pete Brumbaugh at Garmin welcomes your comments and questions — email pete.brumbaugh@garmin.com or phone 913-397-8200. I'm on the review list, and I'll let you know the outcome soon! **NV**

Electronics Q&A

With TJ Byers

In this column, I answer questions about all aspects of electronics, including computer hardware, software, circuits, electronic theory, troubleshooting, and anything else of interest to the hobbyist.

Feel free to participate with your questions, as well as comments and suggestions.

You can reach me at: **TJBYERS@aol.com** *or by snail mail at Nuts & Volts Magazine, 430 Princeland Ct., Corona, CA 92879.*

What's Up:

LVDTs explained ... you might be surprised. Lots of counter circuits for lotsa applications. Cheap data logger and a simple time delay relay. Finally, is there really such a thing as an electronic fuse? You decide.

Linear Displacement Devices

Q. I have a cyclindrical device that's one-half inch in diameter by four inches long, with a spring-loaded plunger at one end and five wires (red, green, black, white, and yellow) at the other end. I am guessing it is an LVDT (Linear Variable Differential Transformer), but I don't have a clue as to how it works. Is it AC or DC, and what is the voltage output?

Peter Stratigos
via Internet

A. An LVDT, which belongs to the group of linear displacement devices, is made of three coils, placed side-by-side, wound on a common form or bobbin. The center coil — the primary or exciter coil — is excited with a sinewave voltage normally in the region of 1kHz to 30kHz at 0.5 to 10 volts. The other two coils — the secondaries — are wound such that when a ferric core is in the central linear position, an equal voltage is induced into each coil. (Figure 1)

The secondaries are connected in opposition so that, with the core in the central position, the outputs of the two secondaries cancel each other out. As the core moves back and forth, the induced voltage in the secondary windings decreases and increases. In order to know in which half of the secondary coil the core is located, the phase of the output, as well as the magnitude, has to be measured. This is done by comparing the secondary phase with the excitation phase.

National Semiconductor makes an LVDT signal conditioner — the NE5521 — for use with a linear and rotary variable differential transformer (RVDT). An RVDT is identical to an LVDT, except that the core motion is rotary. A typical NE5521 application uses just five external parts and an optional low-pass filter, as shown in figure 2.

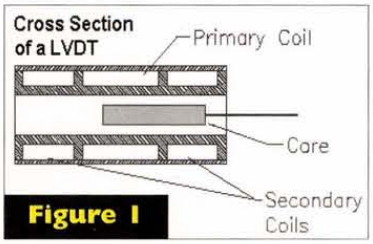


Figure 1

Digital Delay

Q. Our son, Tim, is a graduate research assistant at the Univ. of Wisconsin (Madison), where he is involved in Medical Ultrasound research. His problem involves an ultrasound scanner that produces an output somewhat like video. The frame rate is 10 Hz to 40 Hz, and the scan rate is 100 to 300 lines per frame. The outputs are analog for the "video" and TTL level for the frame and scan line pulses. The team wants to view a single line of each frame on an external oscilloscope, which they can do using a delayed sweep for the top lines of the frame. However, to view the bottom lines at 10 Hz per second requires a delay of 100 mS and the scope has a maximum delay of 1 mS.

Tim suggests two approaches. The first would be to use a variable digital delay, with upper delay of 50 mS to 100 mS, feeding the frame pulse to the scope's external trigger. The second is a line counter which counts line pulses beginning with each frame pulse and triggers the scope at the desired line.

William Stiles
via Internet

A. Here is a programmable line counter (Figure 3) that will serve as a stable oscilloscope trigger delay. The first counter counts up to 16 and the second counts up to 256, offering a full range of numbers between 0 and 256. The switches set the delay time by grounding selected inputs to equal the line number you wish to single-out for viewing. Notice that the switches are coded in binary format, so if you want to trigger a delay for 80 lines, you enter the values of 16 + 64. After the programmed count is reached, the TC (carry out) output of the second stage reloads the "delay" switch settings and starts the count again.

Of course, for this counter to

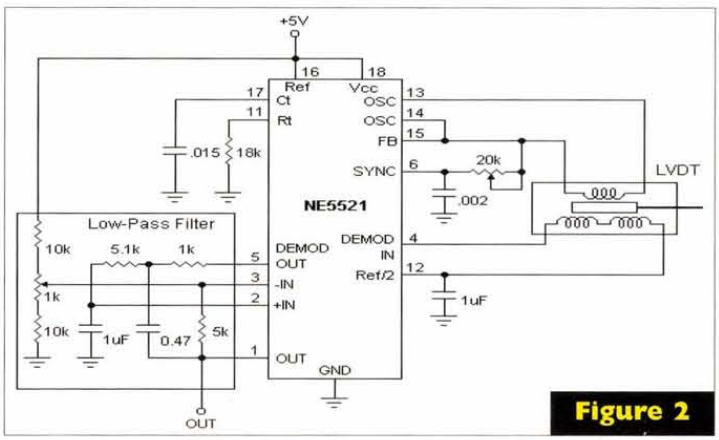


Figure 2

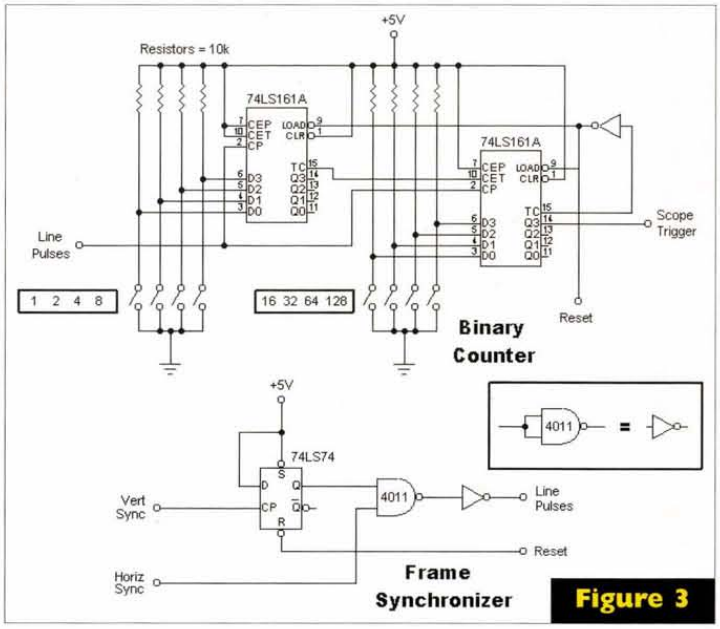


Figure 3

work, the roll-over count must equal the number of scan lines in the frame. Without knowing which line the scope is synchronized onto, the counter will wander between scan lines. A way to correct this problem is to use the vertical retrace blanking pulse to synchronize the counter to the frame. The lower circuit, Frame Synchronizer, should provide that function — with some reservations. First, you have to have access to both the horizontal and vertical sync pulses. If they are combined, as would be the case with composite sync or sync on green, you need to run the signal through a sync separator. Second, the Frame Synchronizer assumes negative blanking pulses for the horizontal and vertical retrace. If not, you will need to add inverter gates as needed to correct the polarity.

There is another approach that doesn't require separate horizontal and vertical sync pulses, but does require a separate counter to reset the Binary Counter. This can be done using the existing outputs, or via a parallel binary counter. Unfortunately, it doesn't sync on the beginning of the frame, just the same line over and over, which requires some math intervention and additional hardware chips. An advantage to this approach is that it provides a manually-adjustable trigger line that moves up or down, which may be advantageous. Let me know if you need further help.

Data Logging On The Cheap

Q. I have a vacation cabin in a rural area where the electricity is sometimes out for minutes, hours, or even days at a time. Since this cabin is unoccupied most of the time (it might be a month or so between visits), I would like to have some sort of simple device that would allow me to see when, and for how long, the power was off. I am thinking of some sort of recording timer — either mechanical or electronic — that I could view on arrival to determine just how long the freezer, etc., was inoperable. Any ideas?

John Seibels
Columbia, SC

A. The easiest and cheapest answer is to use a totalizer that adds up the minutes the power is off. Such a circuit can be made using a relay — RadioShack counter (910-4910) — and a clock pulse, as shown in the schematic below (Figure 4). When the power is on, the relay is engaged and power to the pulse generator is disconnected. When the AC power fails, the relay applies voltage to the pulse generator. I've taken the liberty of making the circuit very simple by assuming 64 seconds per min is an acceptible error. That amounts to 1.5 hours per day. Otherwise the design would require a lot more circuitry, and according to your schedule, the error is no big deal.

The problem, of course, is that a totalizer doesn't tell you when the power failed or for how long per event. For that you need a data logger, which doesn't come cheap. Then it hit me! There are plenty of data loggers on the surplus market that can be had for as little as $10.00. I'm talking about temperature chart recorders of the paper disk variety (not paper strip recorders) — the kind used to monitor walk-in freezers and warehouses. They come in wind-up, battery power, and AC (with battery back-up) versions, and can record data for days or weeks. To record your power on/off periods, simply place the temperature sensor close to an incandescent night light and start the platter spinning. When the power fails, the lamp goes out, and the sensor will record the drop in temperature.

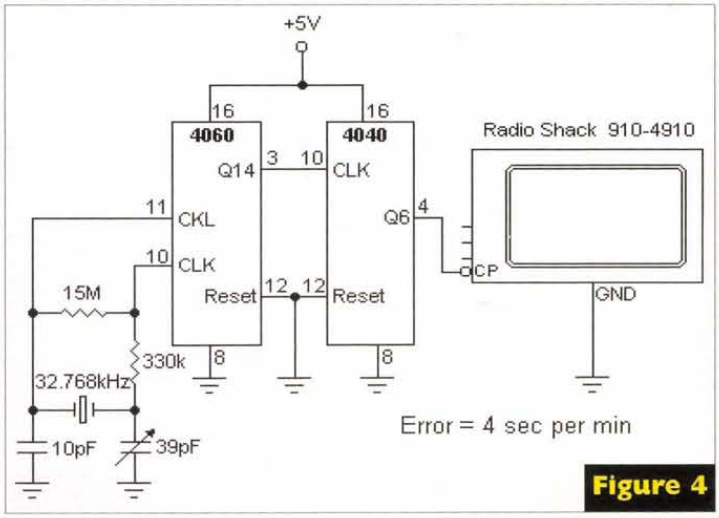


Figure 4

PC Boot Delay

Q. I have modified a connector to one of my PC's power leads that makes a branch line carrying 12 VDC that I use to operate an external relay which switches on the 120 VAC power for the monitor, printer, scanner, and other computer devices. The relay arrangement works fine, but I would like to have a delay of 5 to 10 seconds to let the hard drive get up and running before the external peripheral devices start up. Please provide me with a diagram for a circuit that I can package in a small "project box," which will detect the presence of the 12 volts from the computer and then wait 5 to 10 seconds before engaging the relay.

R. Brelsford
South Carolina

A. Here's a small circuit that'll do your bidding. (Figure 5) It's a single transistor switch that can't turn on until the voltage across the 100uF capacitor reaches about nine volts. If you wish to adjust the delay, the time it takes before the relay pulls in is approximately t = RC.

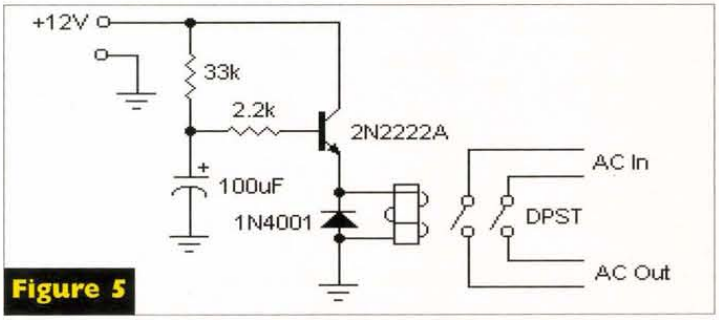


Figure 5

Ahoy, All Volts Aboard!

Q. My question concerns the voltage requirements for marine radar, chartplotters, sounders, and similar devices. The voltage input for some of these instruments ranges from 11 to 40 volts, while others specify 12/24 volts. Why the difference in the input voltages? Do they assume that large boats with big diesel engines have 24-volt systems, while those under 35 feet have 12-volt systems? Is 30 or 40 volts better than 12 volts? I want to install a sounder/fishfinder, but I'm so confused by all these voltage differences.

Rickey Boggiatto, Sr
via Internet

A. The marine industry has three voltage standards commonly found on small boats: 12, 24, and 32 volts. And yes, the voltage tends to increase with the size of the boat and the horsepower of the engine. Marine elec-

Cool Web Sites!

Crimeboss — History of crime comics of the 1940s and 1950s. Includes a large cover gallery.
http://www.crimeboss.com/

The Blue Highway — The history of the blues is more than a musical chronology.
http://thebluehighway.com/

Red Hot Jazz Archive — History of Jazz before 1930.
www.redhotjazz.com/

Historical Atlas of the 20th Century — Keeping the Turn of the Century in perspective
http://users.erols.com/mwhite28/20centry.htm

Figure 6

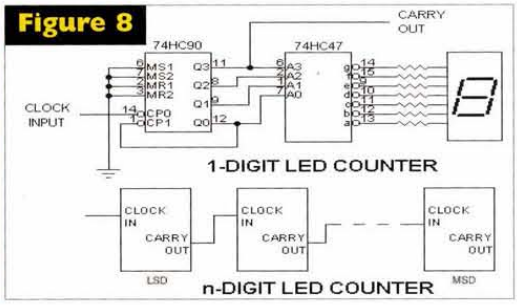


Figure 8

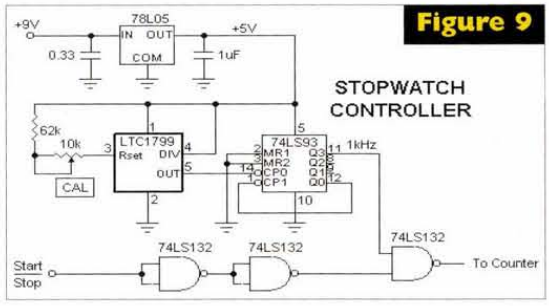


Figure 9

tronics that advertise 11- to 40-volt input have a circuit that automatically converts the input voltage to the working voltage used inside the unit. Systems that say 12/24-volt operation often have a selector switch on the unit that selects the proper input voltage. Regardless of the input voltage, the voltage inside the instrument is independent of the input voltage, so there's no advantage to using 32 volts over 12 volts — except for the way the unit is installed. The lower the voltage, the higher the current requirements and the larger gauge wire is needed to overcome voltage loss in the wiring. For example, if the unit is rated two amps at 12 volts, it will only draw one amp at 24 volts.

Make Way, Coming Through!

Q. I need to increase the voltage that powers a vehicle back-up alarm in order to make it louder. The alarm is rated 12 to 72 VDC, and is presently driven by my 12-volt (car battery) back-up tail lights.

Peter Stratigos
via Internet

A. Unless it's a really cheap unit, which yours isn't, increasing the input voltage won't increase the loudness of the alarm. You see, the sound level is regulated by law at 107-109 dB measured at a distance of one meter (97 dB at four feet). As the voltage increases, the alarm automatically adjusts to the new voltage, thus maintaining a constant sound level.

An interesting item that I ran across in an auto parts store the other day is the Back-Up Alert Beeper (Figure 6) which combines a halogen lamp with a back-up alarm. Simply remove your existing back-up lamp and replace it with this device. Now each time you shift into reverse, the halogen lamp lights and the beeper beeps at a non-disruptive 87dB.

Precision Stopwatch

Q. I am looking for a stopwatch circuit for a Drag Racing simulation game. I need a circuit with a display that can count up and has an accuracy of 1/1000 second (00.000).

Wayne Duvall
via Internet

A. At first I thought this would be an easy question. Simply locate an inexpensive stopwatch kit and steer you that direction. As it turns out, they don't exist. So I'm doing the next best thing, adding a stopwatch function to a counter.

The type of counter isn't important. Any instrument with an input frequency of 1 kHz or better will work. Okay, this is supposed to be a DIY magazine, so I went back to a counter design that has become a staple of the industry — and is abundantly available in kit form for about $20.00 to $30.00. Here is a short list of suppliers (Listing 1) and a schematic. (Figure 7)

These kits increment the timer in multiples of three digits, so I've included an older design (which I believe is no longer in kit form) using the 74LS90/74HC90 that allows you to add the digits one by one. (Figure 8) The unlabeled resistors can vary between 100 and 470 ohms, depending on the LED brightness.

Now we come to the crux of the matter — the stopwatch controller (Figure 9). For this, a stable 1-kHz oscillator is needed. After considering several options, I opted to go with the recently-introduced LTC1799 precision oscillator chip from Linear Technology (available from **Digi-Key: 800-344-4539; www.digikey.com**). and occupies very little PC board space. The oscillator frequency is programmed by a single, external resistor and has an accuracy of 1.5% or better without the need for external trimming components. My design includes a 15-turn trimmer resistor to achieve accuracy of better than 0.1%. The 16.000-kHz frequency is divided by a 74LS93/74HC93 ripple counter to produce a stable 1-kHz clock pulse.

This 1-kHz clock is gated through a NAND gate to display the elapsed time of your dragster. The Start|Stop input is buffered by two 74LS132/74HC132 Schmitt NAND gates to sharpen the rise-time and prevent false triggers by establishing a hysteresis zone. As shown, the stopwatch controller will start the timer when a positive voltage is applied to the input and stop the timer when the input is grounded. If your logic is the reverse (low on, high off), remove one of the 74LS132 inverter gates.

Pop Goes The Fusel

Q. I am trying to make an electronic fuse using transistors that work like a mechanical fuse. I've tried various designs over the years and have never been able to make them work properly. Could you please provide me with a circuit?

Cletus Bell
Louisville KY

A. I have a feeling that the designs you have been looking at are really current limiters, and not electronic fuses. To behave like a fuse, the load has to be disconnected from the power source. My first design — Figure 10, ELECTRONIC FUSE — uses an SCR as the disconnecting element.

When power is first applied to the circuit, the TIP120 pass transistor conducts via base current supplied by the 470-ohm resistor. This, in turn, causes a voltage to develop across R1 that's proportional to the current flow. When the voltage across R1 exceeds about 0.7 volts, it triggers the gate

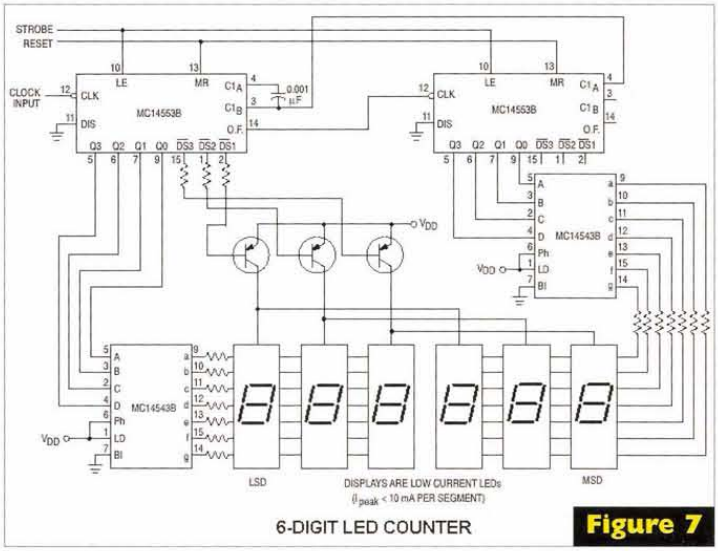
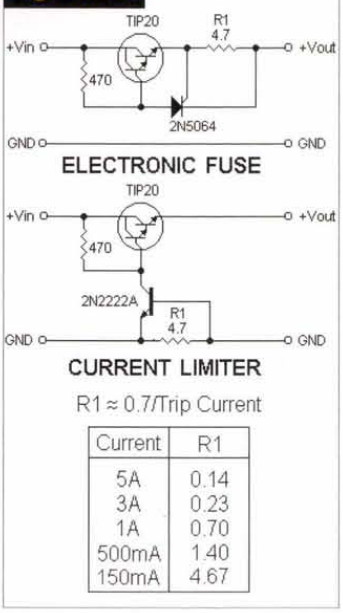


Figure 7

Listing 1

www.web-tronics.com/kit1thredigl.html
www.qkits.com/serv/qkits/diy/pages/QK1.asp
www.wiltronics.com.au/listproducts.asp?prod_id=172&cid=23
www.quasarelectronics.com/counters_timers_meters.htm
www.ozitronics.com/kitlist.html
www.electronics123.com/amazon/catalogue/c3-3-4.htm

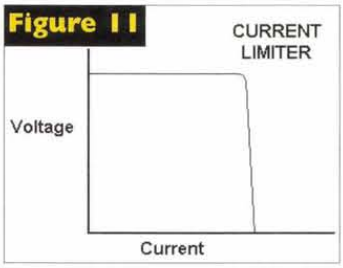
Figure 10



R1 ≈ 0.7/Trip Current

Current	R1
5A	0.14
3A	0.23
1A	0.70
500mA	1.40
150mA	4.67

Figure 11



of the 2N5064 SCR, which shorts the base of the pass transistor to its emitter, which turns the transistor off. Now it's the nature of an SCR to keep on conducting even after the trigger source is removed. Consequently, the fuse remains "open" until the short is removed or the power is turned off (the SCR will continue to short out the pass transistor until the current drops below 5 mA).

However, having to manually reset a blown fuse isn't always desirable or practical. That's why a lot of "electronic fuse" circuits are actually current limiters. This device works by sensing the current through the load, and putting a limit on the current allowed. If we were to draw a graph of this action, it would look like a shear cliff, (Figure 11) where the output voltage drops sharply as the load resistance decreases.

This is done with a 2N2222A NPN transistor which has the current-sensing resistor (R1) connected between its base and emitter. When the voltage across R1 exceeds 0.7 volts, the transistor begins to conduct, which effectively shunts the pass transistor's (TIP 120) base current to ground and holds the output current at that level no matter how much current the load may demand. At higher currents, you will want to heatsink the TIP120 because it will be operating in its linear region.

Why the two designs? As mentioned before, the electronic fuse is a one-time shot that has to be manually reset like a circuit breaker. The second is self resetting after the short or overload is removed. But there's something else. Notice that the upper circuit senses the current from the high side of the line, whereas the current limiter takes its cue from the lower line. When you sense the lower line, it inserts a resistance from the load to ground (hence, a voltage drop), which isn't always desirable. You choose.

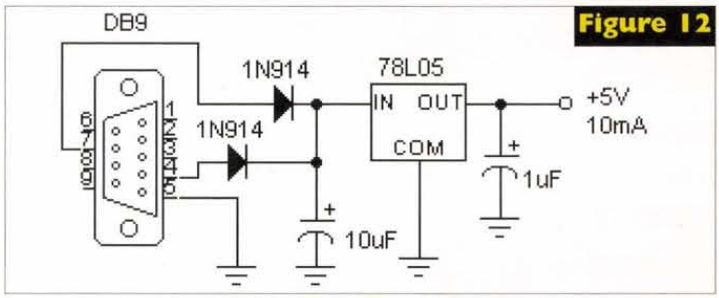
LCD Math

Q. I want to drive an LCD display from a computer with a VGA output using a VGA/NTSC converter. The display has a NTSC input and a resolution of 1152H x 234V. Would this work for displaying PC text and graphics, even though the VGA output is 640H x 480V?

David Kamulski
Oxford, MI

A. Yes, it will display your PC graphics and text, but maybe not the way you are expecting. There are two factors involved here, the most critical being the difference in the number of vertical lines. The VGA has a resolution of 480 vertical lines, of which only half can be seen on the display. The result is degraded text and graphics quality. The second factor is the screen aspect ratio, the ratio between the vertical and horizontal dimensions of the image. For the VGA format, that ratio is 1:1.3; your screen has an aspect ratio of 1:5, which means the horizontal resolution of your VGA image will be reduced from 640 to about 320 after the NTSC converter corrects for the aspect ratio. Still want to use your new-found treasure?

Figure 12



Serial Port Power, Revisited

Q. In the Dec. 2001 issue, you advised Jack Simpson as to how he could power his PIC circuit by stealing power from the serial port. I am making an isolation circuit for my parallel port using 6N137 optocouplers, and would like to power the gates that feed back into the status and control portions of the parallel port with power from the serial port. Do you think that the serial port will supply me the current I require?

Brian Rippie
via Internet

A. Well, that all depends because the maximum current you can "steal" from the serial port is about 10mA. According to the 6N137 datasheet, the guaranteed trigger point is 5mA, which means you only have enough current to power two devices. However, a closer look at the datasheet reveals that 2.5mA will work in all but the most extreme conditions, which is sufficient to drive four 6N137 gates. However, the parallel interface has five inputs, so you may have to find a way to work with just four input lines to pull this off. Or, if you have access to a lot of 6N137 chips, you can sort through them and pick out those which have the lowest current requirements. For those readers who missed the circuit Mr. Rippie is talking about, here it is again. (Figure 12) **NV**

BATTERIES FOR EVERY ELECTRONIC APPLICATION

Authorized Sanyo Battery Distributor

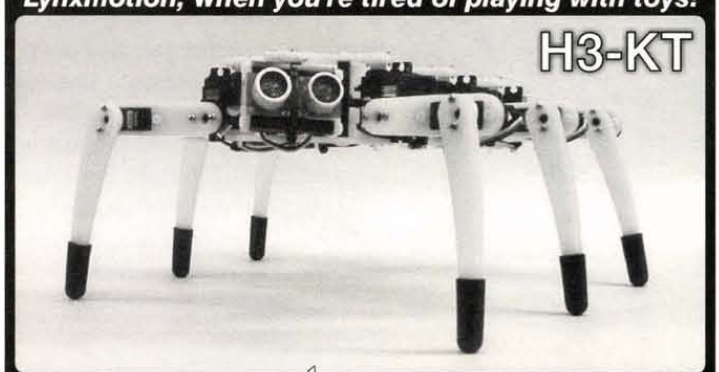
See us at batterystore.com

21 years of Battery experience

TNR Technical, Inc.
Sanford, FL • 800-346-0601
Santa Ana, CA • 800-490-8418

Circle #43 on the Reader Service Card.

Lynxmotion, When you're tired of playing with toys!



Lynxmotion, Inc.
PO Box 818
Pekin, IL 61555-0818
www.lynxmotion.com

Lynxmotion
Visit our website or ask for our free catalog!

Tel: 309-382-1816
Fax: 309-382-1254
sales@lynxmotion.com
tech@lynxmotion.com

Circle #44 on the Reader Service Card.

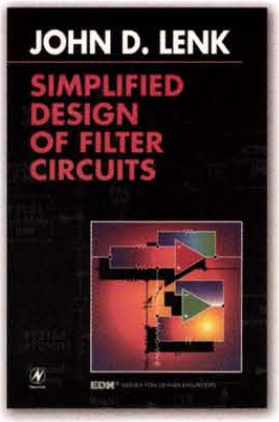
Keep your electronics library up-to-date with these latest reads —

New Books

Simplified Design of Filter Circuits

by John D. Lenk

$24.99

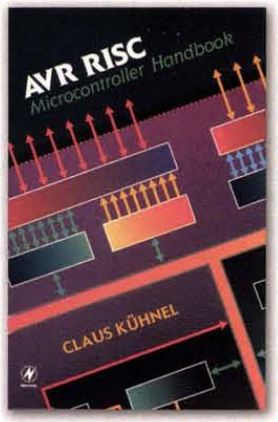


Simplified Design of Filter Circuits, the eighth book in this popular series, is a step-by-step guide to designing filters using off-the-shelf ICs. The book starts with the basic operating principles of filters and common applications, then moves on to describe how to design circuits by using and modifying chips available on the market today. Lenk's emphasis is on practical, simplified approaches to solving design problems.

AVR RISC Microcontroller Handbook

by Claus Kuhnel

$39.99

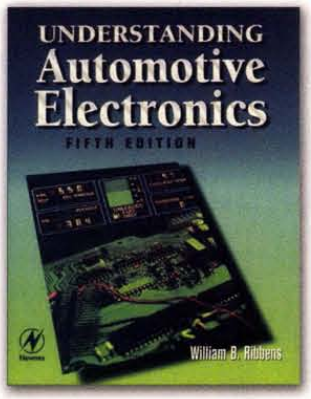


The *AVR RISC Microcontroller Handbook* is a comprehensive guide to designing with Atmel's new controller family, which is designed to offer high speed and low power consumption at a lower cost. The main text is divided into three sections: hardware, which covers all internal peripherals; software, which covers programming and the instruction set; and tools, which explains using Atmel's Assembler and Simulator (available on the Web) as well as IAR's C compiler.

Understanding Automotive Electronics Fifth Edition

by William B. Ribbens

$34.99

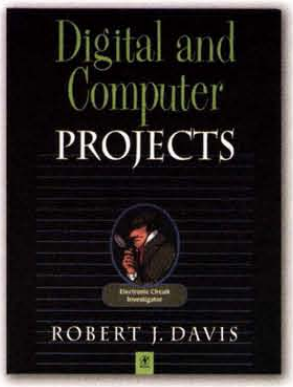


This edition of *Understanding Automotive Electronics* covers the most recent technological advances in operation and troubleshooting of electronic systems and components. This is a practical text, suitable for the automotive technician, student or enthusiast. It includes low-emission standards, on-board diagnostics and communications, digital instrumentation, and digital engine control.

Digital and Computer Projects

by Robert Davis

$24.99

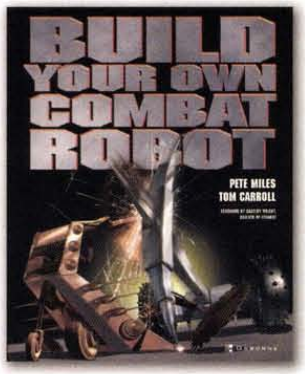


Compiled from the author's research for articles published in *Nuts & Volts* magazine, this book is filled with digital electronics projects and projects that involve computer peripherals. It is divided into digital projects, from Epson copiers and adapters to quiz machines; printer port projects, from a digital storage oscilloscope to an audio mixer; and monitor projects, from VGA adapters to conversion of monitors to 31 KC operation.

Build Your Own Combat Robot

by Pete Miles and Tom Carroll

$24.99

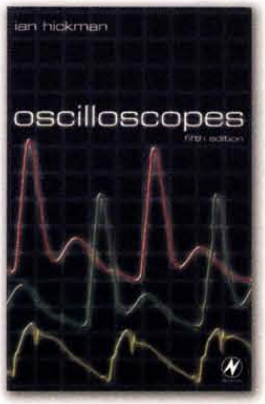


Build a powerful and invincible robot — for full-blown competition or just for fun — using this authoritative robot resource. This team of experts gives you an inside look at the innovative new world of robotic combat, explaining the origins of the sport as well as all the elements that go into constructing a fighting robot. Learn technical basics from motors and wiring to locomotion, and read builders' true stories from the front lines of robot competition. Whether you're mechanically minded or not, you'll find this book both entertaining and informative.

Oscilloscopes Fifth Edition

by Ian Hickman

$39.99



Oscilloscopes are essential tools for checking circuit operation and diagnosing faults, and an enormous range of models are available. But which is the right one for a particular application? Which features are essential and which not so important? Ian Hickman has the answers.

This handy guide to oscilloscopes is essential reading for anyone who has to use a 'scope for their work or hobby: electronics designers, technicians, anyone in industry involved in test and measurement, electronics enthusiasts... Ian Hickman's review of all the latest types of 'scope currently available will prove especially useful for anyone planning to buy – or even build – an oscilloscope.

These new titles can be ordered from the *Nuts & Volts* Bookstore.
Call **1-800-783-4624** or visit our web site at **www.nutsvolts.com**

SERIOUSLY SIZED SERVOMOTOR SLIDE, provides 21" of precise travel. But Wait...There's More!

These heavy duty, motorized linear slides, do their sliding on 3/4" diam. Thompson steel rail. The X axis is motivated by a substantial 3.4" diam. EG&G servomotor type: ME3515-191B with an EG&G 1000 count encoder driving a flex coupled 1/2" pulley which belt drives 2.2" diam. transfer pulley which direct drives the 1.5" final drive pulley which moves the 0.6" wide toothed belt which moves the carriage. The X axis carriage contains a motorized rotary unit with the same type EG&G servomotor driving a 5.5" diam. 1/4" thick aluminum platter mounted at about a 20 degrees angle to the base. Rotation is via an anti backlash gearing system directly driven by the motor. Supporting all these goodies is a welded, 3" wide steel channel frame. The system overall size is: 45"L x 14.25"W x 8.75"H. These units must ship via truck. Very limited quantity. These are used in good condition.

XSLIDE-ROTARY..... $229 ea. or 2 for $399

WOW! OPTICAL EXPERIMENTERS DELIGHT, DUAL PHOTO DIODE DETECTORS and FIBER OPTICS to boot!...

These unique assemblies are removed by us from a precision optical systems. The goodies provided go something like this: Two silicon photodiodes from Hammamatsu. One type 2386-18K, 1.2 mm ^{2} active area, 5pA dark current in a TO-18 pkg. and one type 2387-66R, 33mm^2 active area, with high linearity and 50pA dark current in a flat glass/ ceramic package. Both with usable sensitivity from 320nm to 1100nm and a peak sens. @ 960nm. These beautiful detectors are each mated with a Burr Brown OPA111BM, low noise high performance amplifier. The amps alone are currently over $8ea in 1000 qty. High quality 10,000Mohm resistors are on board as well. Power is via ±15VDC through 14" long ribbon I/O cable. The entire PCB is enclosed in a removable shielded enclosure. There is a 1.3"L x 0.4"H opening in front of the large area detector. Also provided is a 7" removable fiber optic cable which provides the input to the small area detector. Originally the system provided large area signals through a color filter wheel an main lamp feedback through the F.O. cable. A super little unit. Overall size: 5.2"L x 2.8"W x 2" H We provide the manufacturers data sheets for the detectors and the amplifiers as well as the power connection info. The rest is up to you. This is a beauty. These are removed by us from new optical equipment. **DUAL DETECTOR.... $19 ea. or 4 for $49**

NEW, GM960R TIME LAPSE VIDEO RECORDER

Finally a brand new, 4 head, T/L recorder with all the features at a price you can afford. Features: • Up to 960 hours on a standard T-120 VHS tape.• 12 different modes for record and playback • Audio recordina in the 12H and 24H mode. • 30Day memory backup • Easy mode setting.• On- screen menus • Auto-Repeat recording mode • Serial or One-shot recording • Time, Date, speed, and Alarm indicators on screen. These deluxe units are front loading and are 14"W x 3.5"H x 12.2"D, 110VAC powered.

SPECIAL, GM960R-VCR .....$379ea.

INCREMENTAL OPTICAL ENCODER, LUCAS/LEDEX TYPE: S-10208A-1386. Provides 1386 counts per rev! That's 5544 counts per rev in quadrature!

5VDC powered. TTL compatible outputs of: A A, B B and M M, 1/4"diam. x 1/2"L, ball bearing shaft. Size: 2.3"diam x 1.9"deep Removed from equipment. A super value.

LUCAS-ENC1368.....$39ea.

NEW, VICOR, DC/DC CONVERTER. Type: V48C3V3C75A002

The latest design provides 3.3V@ 75Watts form 48VDC @ 97W input. Mini size: 2.3"L x 1.4"W x 0.55"H. These are brand new and very pricey. At full output, adequate cooling is required.

VICOR48/3.3..... $20 ea. or 3 for $49

WE ARE LOOKING for UNIQUE ELECTRO-OPTICAL, MOTION CONTROL DEVICES and RELATED. PLEASE FAX US YOUR LIST of AVAILABLE MATERIAL.

CARL ZEISS, S-PLANAR LENS,

GCA type 37, 1.4/75, M1:5nA=0.30, A fantastic lens with a current replacement cost of $20K. Extremely flat field and extemely high quality. Removed from wafer-lithography system, excellent condition. **ZEISS-PLANAR.....$495**

A SECOND SERIOUSLY SIZED SERVOMOTOR SLIDE, By ANORAD, Provides 23.5" of Precise Travel. But Wait...There's a Z AXIS BONUS!

These SUPER HEAVY DUTY, motorized linear slides, do their sliding on crossed roller bearings. The X axis is motivated by a 2.25" diam. EG&G servomotor type: MT-2130-012BE or similar with encoder driving a flex coupled 0.75" diam. ball screw drive. The huge carriage is: 28" L x 5.5" Wx 1.1" Thick. The X axis is a massive precision machined (Mehanite) casting. Mounted to the carriage is a substantial Z axis unit sporting dual THK, YH2218, 0.6"H x 0.5"W rails or similar. Riding the rails are four recirculating ball carriages attached to a 1/4" thick aluminum plate. (Two carriages on each side) Running down the center is a 1/ 2" diam. ball screw driven by a size 23 stepper motor. This motor provides the drive for the 10.5" travel, Z axis. These units were originally designed to be used in a "gantry" configuration. ie. suspended over the workpiece with the workpiece moving in the Y axis. Overall size is 48"L x 17"W x 20"H. This is the perfect setup for heavy duty cutting or engraving. Slides of this quality don't come around very often. Don't miss out. We have a very limited quantity. These units must ship via truck. These are used in good condition removed from optical equipment. **ANORAD SLIDE.. $349 ea. or 2 for $649**

NEW! 6.8" LCD COLOR, TFT, ACTIVE MATRIX DISPLAY, A huge 23sq. inch VIEWABLE AREA, Super Deal. 2.8X the VIEWING AREA of a 4"

WOW! We wish you could see the color saturation and resolution of this superior LCD display. Excellent contrast ratio, high quality, full color images are comparable to a CRT. Perfect, portable, general purpose color monitor for standard NTSC color or B&W video. Fully compatible with all our cameras as well as Camcorders, VCR's, DVD's etc. OEM "component" style unit has no outer cabinet. Designed to be installed in YOUR housing via four mounting tabs as shown. Specs: Resolution, 1152H x 234V, 270K Pixels! Viewing angle, Top 10°, Down 30°, Left 45°, Right 45° . Brightness, 300 nit, Size: W x H x D (mm/in), 157.2 x 122.6 x 8.0, 6.2" x 4.83" x 1.1", Weight, 10oz. Supplied with 30" input cable. Video input via BNC jack , 12VDC input via a standard barrel connector.

BRAND NEW, FIRST QUALITY. GMTFT68.....$169ea.
Regulated 12 VDC/110VAC power supply.....$8.95ea.

A VIDEO MICROSCOPE in the PALM of your HAND! NEW, MAGCAM, VIDEO INSPECTOR, OFFERS HIGH POWER and LOW COST. Two optical magnifications at the flick of a lever. Choose either 40X or 140X.

A high quality, digital, color CCD camera, with dual optical magnification settings and built in object illumination via two ultra bright, white LED's. Entire system is fully integrated into a rugged and ergonomically designed, hand held unit only 2.7"W x 3"H x and 1.8"D Video output is standard NTSC via a RCA jack. 12VDC powered. CCD provides 380 lines of resolution and 0.8lux sensitivity . Complete with power supply and 3 foot RCA cable. A fantastic and useful device for inspection, diagnostics and observation of small objects. Perfect for SMT inspection.

SPECIAL, GM- MAGCAM....$199ea.

NEW, LINEAR BALL SLIDES from DCI,

Three models available: The large is 6"L x 2.6"W x 1"H with 4" of travel. The medium is 5"L x 2.6"W x 1"H with 3" of travel. The small is 1.75"W x 1.75"L x 0.75"H with 1" of travel with a removable spring return for use against a micrometer or similar. Features common to all include: Solid machined aluminum with anodized construction, hardened steel ways. Slides are usable in any position and can carry heavy loads. Over 100lbs for the large and medium and 25lbs for the small. Straight line accuracy of 0.00008"/inch of travel. All are new. Limited quantity. **DCI-LONG.....$69ea.**
DCI-MEDIUM.....$59ea.
DCI-SHORT.....$39ea.

NEW, 470 LINE, DSP COLOR Micro CAM The HIGHEST PERFORMANCE available. MICRO SIZED PACKAGE too!

Yes 470 lines with a 60db S/N ratio to back it up! That's 16X better than a typical 46dB standard camera! The GM-4500, CCD camera with its' DSP technology provides high speed white balance with no color rolling. Auto shutter speed of 1/60 to 1/120,000 second. Truly state of the art. Sleek cast aluminum housing protects the 18mm x 26mm pc board inside.Mounting bracket & 18" cable with BNC video and DC pwr. jack for, no sweat hook up. requires only 12VDC@ 65mA. Optional mirror function available. Why fool around with an open P.C. board? This camera has it all. • 1/4" CCD • 1 Lux • AGC • Auto Shutter • 270k pixels • Std. 3.7 mm, 68° FOV lens • Focus:10mm to infinity • 3<ounce! • Size (mm): 33W x 29H x 30D **GM-4500-STD, SPECIAL...$99ea.**

NEW! 0.005 Lux, COLOR NIGHT VISION CAMERA! UNBELIEVABLE LOW LIGHT PERFORMANCE. State of the Art Video, Exclusive ON SCREEN, menu driven setup of all camera parameters!

For covert, military & scientific applications that must be color, this is it. Unbelievable 0.005Lux @ f1.2 performance is enhanced through low speed electronic shuttering, digital frame integration and advanced DSP. Auto sensitivity mode starts as it becomes dark. 24 hour surveillance is possible with the optional f1.2 auto iris lens shown below. Seven Gain/Shutter modes are user selectable. Normal, X4, X8, X16, X24, X32, X64. These provide frame rates of 60, 15, 8, 4, 3, 2 and 1 per second. Auto/Man. white balance 3200° to 10000°K, auto/man BLC, S/N >52dB, Mirror on/off, Gain on/off, auto electronic shutter 1/60 to 1/120,000 sec., Alum. housing, dual 1/4x20 mtg. Specs: 1/2" CCD, 768(H) X 494(V), with 380K pixels, 470 Lines, 12VDC ±1V@200mA, Std. video out on BNC. Size: 51mm x 51mm x115mm long. Regulated power adapter included. All functions can be externally controlled. Use standard c-mount lens not included.

GMV-3K-OSD.....$449ea.
High performance auto iris lens, 12mm, f1.2...$199ea.

ORDERS. 800.810.4070
Tech 603.668.2499

RESOURCES UN-LTD.

Fax 603.644.7825, All CCards, COD,
300 Bedford St, Manchester, NH 03101

WWW.RESUNLTD4U.COM

NEW! WEATHERPROOF B&W mini TUBE CAMERA Industrial strength, solid machined housing.

Sleek black anodized, BRASS, housing is O-Ring sealed & WATERPROOF. Adjustabe mount included. Specs: 1/3" CCD, 400 Lines resolution, 0.05 Lux sensitivity, AGC, Auto Shutter. Operates on 12VDC @200mA, 4mm, 78° FOV lens, A real glass lens. NTSC video out. Superior construction. SENSITIVE to IR. Ultra small Size only: 1.25" diam. X 2" long. With 60 ft. cable. Great for outdoor use too.

NEW, GM300K-N.....$99

NEW, lower cost, High quality, MINI BOARD CAM,

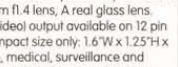
1/3" CCD, 420 Lines Res., 0.3 Lux sens., AGC, Pwr. from 9 to 12VDC @100mA, 266k PIXELS, 3.7mm, 92° FOV lens,A real glass lens. Auto shutter from 1/60 to 1/ 100,000 sec. Focus from 10mm to infinity. Std. NTSC video out. 1/2 ounce! SENSITIVE to IR. Size: 1.25"sq. x 1"d. Connections via a 3" pigtail with PC board connector. **GM-1000B-STD.....$45ea.**

PULNIX, TMC7 INDUSTRIAL 1/2", COLOR CCD CAMERA, with Pentax Lens. For No Compromise Performance.

Specs: 1/2" CCD, 460 Lines resolution, 768H x 494V Pixels, 2 Lux sens. @f1.4, Auto/ Man AGC, Auto/Man Shutter: 1/60 to 1/ 10,000 remotely controllable via 6 pin connector (not incl.) Auto/Man white balance, Manual gain and hue controls are external.Complimentary color filter. 12VDC @320mA, Pwr supply incl. Pentax, 16mm f1.4 lens, A real glass lens. Included. Std. NTSC video out on BNC. Y/C (S-Video) output available on 12 pin connector supplied. Superior construction. Compact size only: 1.6"W x 1.25"H x 5.5" long. Perfect for use in process monitoring, medical, surveillance and microscopy. Used, excellent condition, Regular price $600. Limited quantity.

PULNIX, TMC-7.....$149ea. or 2 for $249

NEW! 4 or 8 CHANNEL, VIDEO AUTO SWITCHERS



Connect four or eight std. video signals and they will be sequentially output to the dual rear panel BNC outputs. Front panel user adjustable, variable dwell 1 to 15 sec per channel. Auto/manual switching with channel bypass. Compact only 8.6"W x 3.7" D x 1.75" H, ac powered. Video loop through.**GM-34, 4 Chan...$65, GM38, 8 Chan...$75**

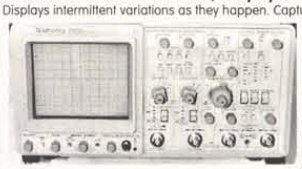
NEW, DAY/NIGHT TECHNOLOGY, OPTIMIZED COLOR / IR OPTICS DSP technology and 10 Automatic LED's. Weather Tight GM450K-IR Makes it Happen

Features include: Interactive infrared illuminator with 10 high power, wide angle LEDs @ 880nm . See objects 60 feet away during total darkness. A super quality 5 element, glass lens, specially coated with a 100 layer optical coating. For perfect focus with white light and a crisp image under infrared. Normally impossible due to the different focal point for IR and visible light. Solid state infrared optical switch provides day time IR cut filter for excellent color. At night infrared filter will turn off to allow infrared to pass. Also, night time IR LEDs will gradually turn on with proper amount of illumination. You can also see color images such as lights and signs at night. Fog free cover glass. Specs: 0.5 lux color sensitivity. 60dB S/n ratio typical. 12" I/O cable with BNC video and DC barrel jack. 120 dB smear rejection ratio. Adjustable mount and C power adapter included. **GM450K-IR.....$199ea.**

NEW! 0.01 Lux, COLOR NIGHT VISION CAMERA! FANTASTIC LOW LIGHT PERFORMANCE. Exclusive ON SCREEN, menu driven setup of all camera parameters. NEW, STATE of the ART, GMV-35KOSD,

Perfect for covert, military & scientific applications that must be color. Unbelievable 0.01Lux @ f1.2 performance is enhanced through low speed electronic shuttering, digital frame integration & advanced DSP. Auto sensitivity mode starts as it becomes dark. 24 hour surveillance is possible with the optional f1.2 lens shown below. Specs: Shutter speed auto or manual, 1/60 to 1/120,000, 60dB S/N ratio!, 154dB Smear rejection!, AGC gain 0 dB to 18 dB. Digital gain 0dB to 12dB. Digital zoom continuous from up to 2X in 0.1X steps. Masking mode allows hiding 4 programmable zones for privacy protection. Camera on screen name. Choose you own name for the camera and display it on monitor for easy identification.) White balance modes: Auto tracking, one push or selection from 3200k, 4800k, 5600k, 7800k, and "double white balance" independent white balance circuit for both bright and dark zone, maintains correct white balance even with combined indoor and outdoor lighting. Programmable 48 zone back light compensation mode for difficult lighting situation. Negative mode for negative film reading. Mirror image and up/down selection for rear view and camera mounted upside down. Seven Gain/Shutter modes are user selectable. Normal, X2, X4, X8, X16, X24, X32, X64. These provide frame rates of 60, 30, 15, 8, 4, 3, 2, and 1 per second. Alum. housing, dual 1/4x20 mtg. Specs: 1/3" CCD, 811(H) X 508(V), with 412K pixels, 470 Lines, 12VDC ±1V@250mA, Std. video out on BNC. Std S-Video out on 4Pin connector. Size: 2"H x 2"W x 4.5" long. Regulated power adapter included. C-mount lens not included. **GMV-35KOSD.....$399ea.**
High performance lens, 4mm, f1.3...$49ea.

SPECIAL PRICE, 350MHz, TEKTRONIX 2467, MICRO CHANNEL PLATE CRT! with 4 Channels, 500ps per div. in normal room light.



Displays intermittent variations as they happen. Captures the slowest one shot events with 4ns per division a 100 fold increase in the visual writing rate over conventional CRT. Features: 1 ns rise time, 500ps/Div time base, 2mV/Div. vertical sensitivity at 350MHz, 20ps time interval resolution, 1Mohm / 50-ohm input, 500Mhz trigger bandwidth, four channels. On-screen waveform cursors provide vertical & horizontal scale factors, trigger level, voltage, time, freq., phase, ratio values and mode indication. With 2 probes, pouch and manual. EX. cond. 90 day warranty.

New..$12K Now SALE, TEK 2467.....$1995.

Circle #49 on the Reader Service Card.

News Bytes

LEDs. Camera. Action! On-line Product Training Videos Bridge the Gap between Cyberspace and the "Hands On"

LEDtronics® now has informational videos featuring LED lighting solutions available for on-line viewing at their website: **www.ledtronics.com**.

These succinct videos bridge the gap between cyberspace and the "hands on" by delivering show-and-tell to the desktop. LED products are shown up close enabling the viewer to see the attention to detail that is inherent in all LEDtronics products.

Each movie features installation and application demonstrations.

Additionally, the videos serve to educate the audience on the primary advantages (e.g., 100,000-hour diode life, amazing energy-efficiencies, solid-state design) of using LEDs over incandescent light.

This site allows you to choose from several player formats and connection speeds to optimize viewing on your computer set-up.

The Internal Revenue Service and Internet Programming & Consulting, Inc., Agree to Promote the Electronic and Online Filing Of Business Tax Returns at www.tax software.com

Internet Programming & Consulting, Inc. (IPC) have signed an agreement with the Internal Revenue Service to promote the electronic and online filing of business tax returns at http://www.taxsoftware.com/.

The agreement supports the IRS' mission to increase the overall volume of electronically-filed business tax returns. This will be the first year that an estimated five million businesses will be able to file Form 1041, U.S. Income Tax Return for Estates and Trusts and Form 1065, US Partnership Return of Income via the Internet.

Company spokesperson Edward Segal said Taxsoftware.com is believed to be the first and only service that allows businesses to prepare, print, and submit these two forms via the Internet.

Under the terms of the agreement, IPC and the IRS will include reciprocal links to each other's Web sites.

Form 1041 is expected to be available for e-filing after the IRS tests it within the next two weeks. Businesses will be able to e-file Form 1120S, US Income Tax Return for an S Corporation, beginning in 2004, when the IRS debuts the Form 1120/1120S e-file program.

The fees to file forms electronically via http://www.taxsoftware.com/ are as follows:

* $25.00 for each 1065 or 1041 return, including up to 100 K-1's. Companies with additional K-1's will be charged an extra $10.00 plus 25 cents per extra K-1.

* Forms 1098, 1099-Series, 5498, and W2-G are free for those who have already filed their 1065 or 1041 returns at http://www.taxsoftware.com.

* Non return-filers will be charged $10.00 for up to 100 forms. Additional Forms 1098, 1099, 5498 and W2-G will be charged an extra $10.00 plus 25 cents per filing of each extra form.

These prices are valid through April 11, 2002. The price will be doubled for tax year 2001 income tax returns that are electronically filed after April 11, 2002.

Filing Deadlines

According to the IRS, the schedule for the e-filing of forms for tax year 2001 is as follows:

Form Series IRS Copy Recipient Copy Form 1065 and all Partnership returns April 15,

We accept Visa, Mastercard, AmEx, and Discover

Attention: TECHIESTUDS Fax: 318-424-9771

To Order Call 1-800-227-3971 www.shrevesystems.com

A MONITOR FOR ANY BUDGET!

14" Voxon VGA NEW ONLY....$59!!!
15" Voxon VGA NEW ONLY....$89
16" Rasterops fixed 832 X 624 ONLY....$79

H.P. 17" fixed res 832 X 724 **ONLY....$79**
H.P. 17" fixed res 640 X 480 **ONLY....$79**
14" VGA refurb **ONLY....$29**

15" 640x870 Raster Full Page Display Refurbished Macs **ONLY....$49**

$39 *Color Composite Display* Great for Surveillance Refurbished NTSC Connectors

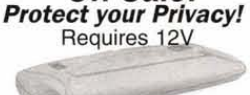
VST External Firewire Case *Accepts any IDE Hard Drive!*

Be sure to check us out on the web at http://www.shrevesystems.com for the best prices on Vintage Mac gear!

Peltier Junction Blowout!
with heat sink, works on 5V &12V
1 3/16î x 1 3/16î

Less Than $5 Each or 4 for $19

Paper Shredders On Sale!
Protect your Privacy!
Requires 12V



ONLY $2

Global Village Bronze External Modem 2400 Bps/9600 Fax

ONLY $.50

RAM
1 MB 30 Pin 4 For $1
4 MB 72 Pin 2 For $5

Miscellaneous	
Apple 8 bit Video Card	$19
LaserWriter IINT	$149
Apple ADB Keyboard	$19
1.44 Super Drive	$19
Clone ADB MouseII	$19
Quicktake 100 Camera	$99
Bernouli 90 MB EXT	$10
44MB SyQuest Ext	$10
88MB SyQuest Ext	$19

CMS SCSI Case
Holds 4 5.25 SCSI full ht. drives

Only $49

ONLY $3

PDA **Genuine Leather** *Carry Case*
Let your palm pilot lead the life of luxury!
Stock up now!

$10

PAS16 Audio Spectrum
For Mac LC Family16 Bit Sound Editing Card

Apple II 256K Memory Expansion Kit
HM51256P-10
ONLY $1

20/30 GB External Firewire Hard Drives
Starting at $169!

Huge inventory! Huge savings!
$25 minimum order.

Shreve Systems
1200 Marshall st
Shreveport, La 71101

Prices reflect a 2% cash discount and are subject to change without notice. Returns are subject to a 15% restocking fee. Not responsible for typographical errors.

Circle #93 on the Reader Service Card.

News Bytes

2002 April 15, 2002
Forms 1098, 1099, and W-2G April 1, 2002 January 31, 2002
Forms 5498 and 5498-MSA May 31, 2002 May 31, 2002
Form 1041 April 15, 2002 April 15, 2002

For more information, go to http://www.inprocon.com/.

TRW's Revolutionary Adaptive Cruise Control Launches with VW Group

TRW Automotive's revolutionary radar-enabled Adaptive Cruise Control (ACC) system on a Volkswagen Group platform is now available to the public. TRW has been selected to deliver ACC on four luxury and mid-range platforms from the Volkswagen Group.

TRW's ACC system is the first on the market to feature MMIC long-range radar sensing technology which tracks information up to 150 meters ahead in all weather and road conditions. The breakthrough radar is the result of an 80 million euro ($69.5 million USD) investment project from Autocruise, a joint venture between TRW and the French defence and aerospace company, Thales.

The information from the radar is analyzed by electronics contained in the unit. The system identifies the vehicle nearest to the driver in their lane and tracks it. If that vehicle is travelling slower than the selected cruise speed, the ACC system sends a signal to the engine and braking system to decelerate until there is an appropriate following distance.

The system maintains this following distance while the vehicle travels below the selected cruise speed. When the road ahead clears, or the driver overtakes, the ACC system sends a signal to the engine management system to accelerate the vehicle to the driver's selected speed.

The company's ACC system uses fully MMIC (Monolithic Microwave Integrated Circuit) based radar sensing technology to detect other vehicles on the road ahead. The core of the radar sensing is a high frequency (77Ghz) TRM (Transmit Receive Module) incorporating the MMIC chips, developed initially for defense and telecommunications use.

Vehicle-specific characteristics, such as acceleration and deceleration rates, are determined by software and can, therefore, allow for feature differentiation across various vehicle platforms based on common hardware.

The radar-enabled ACC system is a step on TRW's technology roadmap for Driver Assistance Systems. These systems ultimately lead to integrated vehicle control systems, comprising active safety features such as vehicle stability control, electric steering systems, and active roll control systems linked with vision, infrared and radar sensing systems. These "smart" sensing technologies will also allow advanced passive safety features such as active retracting seatbelts and intelligent airbag systems. TRW news is available on the Internet at www.trw.com .

The World's First Midrange Blue Book Launches Online

Website Will Revolutionize the Way the Pre-Owned 20 Billion Dollar Midrange Computer Marketplace Buys and Sells Hardware

The Midrange Blue Book, Inc., website, http://thembb.com/, is designed to level the playing field of the pre-owned midrange computer marketplace.

The mission of The Midrange Blue Book is to provide an unbiased arena for end users and dealers to obtain the most current market pricing on manufacturers' hardware like, IBM, Cisco, Sun Micro, HP, and many others.

The Midrange Blue Book does for the midrange computer industry what Kelly Blue Book has done for the used car industry. The site currently covers the market prices on over 50,000 pieces of midrange equipment, ranging from the smallest tape drive to a complete system.

The Midrange Blue Book has employed a team of researchers, who, in conjunction with some of the countries top midrange dealers, work vigorously to ensure that the pricing is always accurate.

TheMBB.com allows users to set profiles of the hardware they own or wish to buy. They can then request to receive monthly e-mail alerts of what the current market value is and to be notified when that equipment's market price changes.

The Midrange Blue Book is available in the form of a Retail and a Wholesale Subscription. The cost of a subscription is $399.00 per year and $125.00 per quarter.

The RF Connection
213 North Frederick Ave.
Suite 11NV
Gaithersburg, MD USA
20877

http://www.therfc.com/

Complete Selection of MIL-Spec Coax, RF Connectors and Relays

UG-21B/U N Male for RG-213/214.....$5.00
UG-21D/U N Male for RG-213/214.....$3.25

N Connectors for 9913/Flexi4XL/9096

UG-21B/9913.....$6.00 **Pins Only**.....$1.50
UG-21D/9913.....$4.00 **Extra Gasket**.....75

Amphenol 83-1SP-1050 PL-259.....$0.90
UG-176/U Reducer RG-59/8X. .25 or 5/$1.00
UG-175/U Reducer RG-58/58A .25 or 5/$1.00
Silver Teflon PL-259/Gold Pin.....$1.00 or 10/$9.00

MIL-Spec Coax Available (Teflon, PVC IIA)

New Product: Belden 9913F. 9913 with High Density PE Foam dielectric, stranded center cond. and Duobond III Jacket.....80/ft or $76.00/100ft

Also New: 9092, RG8X with Type II Jacket
Intro Price.....$23.00/100ft

Call for Specials of the Month

Full Line of Audio Connectors for Icom, Kenwood, and Yaesu

8 Pin Mike Female.....$2.50
8 Pin Mike Male Panel.....$2.50
13 Pin DIN for Kenwood.....$2.75
8 Pin DIN for Icom.....$1.00
8 Pin DIN for Kenwood.....$1.50

Prices Do Not Include Shipping

Orders 800/783-2666
Info 301/840-5477
FAX 301/869-3680

Circle #94 on the Reader Service Card.

AMAZING DEVICES NVEN22001EVEN
See and Order from Our "Action" Web Site at www.amazing1.com

Laser Window Bounce Listener
Powerful listening system, yet simple in operation. You shine a laser at a window and intercept the reflected beam with our ultrasensitive filtered optical receiver. Vibrations on the window from internal sounds and voices are now clearly heard. Range can be up to several hundred meters depending on laser power and optics used.
LWB9 Plans for 3 Laser Window Bounce Systems.....$20.00
LWB6K Kit of 100' visible red for Science Project.....$129.95
High performance modules require housing and simple alignment to make a field worthy LASER WINDOW BOUNCE unit. Shows test tone circuitry, optics and our lab method of a completed assembly
LWB90 Assembled receiver, 10 mw IR laser, collimator etc..$449.95

PLASMA FIRE SABERS
Kits, Parts and Accessories
Duplicates effect in the motion picture epic of the century
Specify blue, grn, pur, red or yel.
Moving light appears to evaporate into space
Blades screw into handle for easy replacement
We stock all size and color blades, *mauler* adapters, tubes digital drivers, and parts for authentic designs. **Wireless *interactive sound modules* change tone with motion**
SAB15 Assbled with 15" Blade..$39.95
SAB24 Assbled with 24" Blade..$79.95 **SAB24K** Kit...$59.95
SAB36 Assbled with 36"Blade.$149.95 **SAB36K** Kit..$129.95

Take Control!! Electronic Hypnosis
Electronic circuitry places subject under your control! Induces ALPHA relaxed mind states.
HYP2 Plans.....$10.00
HYP2K Kit/Plans.....$49.95
HYP20 Ready to Use.....$69.95
MIND2 Plans for Mind Control.....$15.00
MIND2K Kit/Plans.....$49.95
MIND20 Ready to Use.....$79.95

Pain Field Pistol
Caution! Do not aim at people!
Blast out rodents with high power ultrasonics.
Handheld and battery operated with all controls.
Rental units available.
PPP1 Plans.....$8.00
PPP1K Kit/Plans.....$49.95
PPP10 Ready to Use.....$79.95

Jacob's Ladder
A 1/2" arc expands to over 4" as it travels up the Jacobs Ladder evaporating in space.
- **Adjustable arc control**
- **Uses safe high frequency**
- **Safety shock shut down**
- **Full 20" ladder length**
- **110/220 vac 150 watts**

JACK3K Kit.....$149.95
JACK30 Ready to Use..$249.95

30" Spark Tesla Coil
Create a spectacular display of nature's own lightning. Many amazing experiments possible.
See coil in action on our web site!!
BTC4 Plans.....$20.00
BTC4K kit.....$899.95
BTC40 Ready to use.....$1199.95
Smaller Version (8-10" Sparks)
BTC3 Plans....$15.00 **BTC3K** Kit.....$349.95
BTC30 Ready to Use.....$449.95
MINI TESLA COIL *Lights 4' light tube!*
MTC1 Plans...$5.00 **MTC1K** Kit.....$19.95
MTC10 Assmbld for 12 volts.....$34.95

6 Transmitter Kits
1 Super Sensitive Ultra Clear 1 Mile+ Voice Transmitter.
2 1 Mile+ Telephone Transmitter.
3 Line Powered Phone Transmitter Never Needs Batteries!!
4 Tracking/Homing Beacon Beeping Transmitter
5 Video/Audio Rebroadcaster 1 Mi.
6 TV/FM Radio Disrupter. Neat Prank! Discretion Required
Includes Hints Using Wireless Devices
COMBOX Above 6 Kits/Plans.....$59.95
COMBOP Above 6 Plans Only.....$10.00

Hover Board
28 pages of data related to the most revolutionary advance in transportation. Cutting edge R&D
HOVER Plans and Data.....$25.00

Anti Gravity
Float an object using anelectric force field. With handbook
GRA3 Plans/book.....$20.00
GRA3K Kit Pwr Sup.....$99.95
GRA30 Assmbld abve..$149.95

4 KV HV MODULE for *hovercraft, plasma guns, antigravity, pyrotechnics. 12vdc input.*
MINIMAX4.....$19.95

Information Unlimited PO Box 716 Amherst N.H. U.S.A. 03031 E-mail <info1@xtdl.com>
1 800 221 1705 Orders/Catalogs Only! Fax 1 603 672 5406 Information 1 603 673 4730 *Free Catalog on Request*
Pay by MC, VISA, Cash, Check, MO. Add $5.00 S&H Overseas Contact for Proforma

Circle #95 on the Reader Service Card.

DEALER DIRECTORY

The dealers listed below carry the latest issue of Nuts & Volts, for your convenience.

ALABAMA

Little Professor Book Center
2717 S. 18th St.
Birmingham 35209

ARIZONA

Elliott Electronic Supply
1251 S. Tyndall Ave.
Tucson 85713
Tower Records
3 E. 9th St.
Tempe 85281

AUSTRALIA

DonTronics
P.O. Box 595
29 Ellesmere Cres.
Tullamarine 3043
www.dontronics.com

CALIFORNIA

Abletronics
9155 Archibald Ave. Unit E
Cucamonga 91730
All Electronics
905 S. Vermont Ave.
Los Angeles 90006

14928 Oxnard St.
Van Nuys 91411
Alltronics
2300-D Zanker Rd.
San Jose 95131
Centerfold International
716 N. Fairfax Ave.
Los Angeles 90046
Del Amo Books & News
3758 Sepulveda Blvd.
Torrance 90505
Electro Mavin
2985 E. Harcourt St.
Rancho Dominguez 90221
HSC Electronic Supply
4837 Amber Ln.
Sacramento 95841

3500 Ryder St.
Santa Clara 95051

5681 Redwood Dr.
Rohnert Park 94928
JK Electronics
6395 Westminster Ave.
Westminster 92683
Lion Electronic Labs
4948 E. Townsend Ave.
Fresno 93727
Mar Vac Electronics
2001 Harbor Blvd.
Costa Mesa 92627

12453 Washington Blvd.
Los Angeles 90066

4747 Holt Blvd.
Montclair 91763

2000 Outlet Center Dr.
Ste. 150
Oxnard 93030

1759 Colorado Blvd.
Pasadena 91106

2537 Del Paso Blvd.
Sacramento 95815

5184 Hollister Blvd.
Santa Barbara 93111
OPAMP Technical Books
1033 N Sycamore Ave
Los Angeles 90038
Sav-On Electronics
13225 Harbor Blvd.
Garden Grove 92643
The Red Barn
Hwy. 299
Bieber 96009
Tower Books
211 Main St.
Chico 95928

7840 Macy Plaza Dr.
Citrus Heights 95610

1280 E. Willow Pass Rd.
Concord 94520

630 San Antonio Rd.
Mountain View 94040

1600 Broadway
Sacramento 95818

2538 Watt Ave.
Sacramento 95821
Tower Records/Video
220 N. Beach Blvd.
Anaheim 92801

6694 Amador Plaza Rd.
Dublin 94568

5703 Christie Ave.
Emeryville 94608

4118 Fremont Hub
Fremont 9453

5611 Blackstone
Fresno 93710

23541 Calle De La Louisa
Laguna Hills 9265

6310 E. Pacific Coast Hwy.
Long Beach 90803

2331 S Atlantic Blvd.
Monterey Park 91754

2525 Jones St.
San Francisco 94133

871 Blossom Hill Rd.
San Jose 95123
Video Electronics
3829 University Ave.
San Diego 92105

CANADA

Com-West Radio Systems Ltd.
8171 Main St.
Vancouver, BC V5X 3L2
Emma Marion Ltd.
2677 E. Hastings St.
Vancouver, BC V5K 1Z5
Muir Communications Ltd.
3214 Douglas St.
Victoria, BC V8Z 3K6

COLORADO

Centennial Electronics, Inc.
2324 E. Bijou
Colorado Springs 80909
Tower Records/Video
2500 E. 1st Ave.
Denver 80206

CONNECTICUT

Archway News
64 Bank St.
New Milford 06776
Tower Records
1145 High Ridge Rd.
Stamford 06905

DELAWARE

Newark Newsstand
70 E. Main St.
Newark 19711

DISTRICT OF COLUMBIA

Tower Records
2000 Pennsylvania Ave.
Washington 20006

FLORIDA

Alfa Electronic Supply
6444 Pembroke Rd.
Miramar 33023
Astro Too
6949 W. Nasa Blvd.
West Melbourne 32904
Clarks Out of Town News
303 S. Andrews Ave.
Fort Lauderdale 33301
Mike's Electronic Distributing Co.
1001 N.W. 52nd St.
Fort Lauderdale 33309

HAWAII

SolarWorks!
525 Lotus Blossom Ln.
Ocean View 96737
Tower Records
4211 Waialae Ave.
Honolulu 96816

611 Keeaumoku
Honolulu 96814

IDAHO

Current Source
454 N. Phillippi St.
Boise 83706

ILLINOIS

Tower Records/Video/Books
383 W. Army Trail Rd.
Bloomingdale 60108

2301 N. Clark St. #200
Chicago 60614

1209 E. Golf Rd.
Schaumburg 60173

INDIANA

Surplus Bargain Center
2611 W.Michigan St.
Indianapolis 46222

KANSAS

Hollywood At Home
9063 Metcalf Ave.
Overland Park 66212

LOUISIANA

Lakeside News
3323 Severn Ave.
Metairie 70002

MARYLAND

Tower Records/Video
2566 Solomons Island Rd.
Annapolis 21401

1601 Rockville Pike #210
Rockville 20852

MASSACHUSETTS

Tower Records/Video
1011 Middlesex Turnpike
Burlington 01803

MICHIGAN

Anything Goes
5108 Rochester Rd.
Troy 48098
Little Professors Book Center
22174 Michigan Ave.
Dearborn 48124
Purchase Radio Supply, Inc.
327 E. Hoover Ave.
Ann Arbor 48104
Spectrum Electronics, Inc.
1226 Bridge St. NW
Grand Rapids 49504

MINNESOTA

Radio City, Inc.
2633 County Road 1
Mounds View 55112

MISSOURI

Electronics Exchange
8644 St. Charles Rock Rd.
St. Louis 63114

NEVADA

Amateur Electronic Supply
4640 Polaris
Las Vegas 89103
Radio World
1656 Nevada Hwy.
Boulder City 89005
Sandy's Electronic Parts
961 Matley Ln #100
Reno 89502
Tower Records/Video
4580 W. Sahara Ave.
Las Vegas 89102

6450 S. Virginia
Reno 89511

NEW JERSEY

H.E.S. Electronics
1715 Route 88
Brick 08724
Tower Records/Video
809 RT 17 S
Paramus 07652

NEW YORK

Durston's Cigar Store
515 W. Genesee St.
Syracuse 13204
Ham Central
3 Neptune Rd.
Poughkeepsie 12601
Hirsch Sales Corporation
219 California Dr.
Williamsville 14221
Tower Records/Video
105 Old Country Rd.
Carle Place 11514

350-370 Route 110
Huntington 11746

1961 Broadway
New York 10023

NORTH CAROLINA

United Electronic Supply
920 Central Ave.
Charlotte 28204

OHIO

Hosfelt Electronics, Inc.
2700 Sunset Blvd.
Steubenville 43952
Keyways, Inc.
204 S. 3rd St.
Miamisburg 45342

OKLAHOMA

Taylor News & Books
133 W. Main, Ste. 102
Oklahoma City 73102

OREGON

News & Smokes
1060 S.E. M St.
Grants Pass 97526
Norvac Electronics
7940 S.W. Nimbus Ave. Bldg. 8
Beaverton 97005

960 Conger
Eugene 97402

1545 N. Commercial N.E.
Salem 97303
Tower Books
1307 N.E. 102nd Ave.
Portland 97220

PENNSYLVANIA

Tower Books
425 South St.
Philadelphia 19147

Tower Records
340 W. Dekalb Pike
King of Prussia 19406
Tower Records
Land Title Bldg.
100 S. Broad St.
Philadelphia 19110

TENNESSEE

Tower Books
2404 W. End Ave.
Nashville 37203
Tower Records
504 Opry Mills Dr.
Nashville 37214

TEXAS

Electronic Parts Outlet
3753-B Fondren Rd.
Houston 77063
Mouser Electronics
958 N. Main St.
Mansfield 76063
Tanner Electronics
1100 Valwood Pkwy #100
Carrollton 75006
Tower Records
2403 Guadalupe St.
Austin 78705

VIRGINIA

Tower Records/Video
6200 Little River Turnpike
Alexandria 22312

4110 W. Ox Rd. #12124
Fairfax 22033

1601 Willow Lawn Dr.
Richmond 23230

8389 E. Leesburg Pike
Vienna 22182

WASHINGTON

A-B-C Communications, Inc.
17541 15th Ave. N.E.
Seattle 98155
Supertronix
16550 W. Valley Hwy.
Seattle 98188
Tower Books
10635 N.E. 8th St.
Bellevue 98004

20 Mercer St.
Seattle 98109

WISCONSIN

Amateur Electronic Supply, Inc.
5710 W. Good Hope Rd.
Milwaukee 53223

WYOMING

Western Test Systems
2701 Westland Ct. #B
Cheyenne 82001

CALL TOLL-FREE
(800) 292-7711 Orders Only
Se Habla Español

C&S SALES

Secure On-line Ordering @ cs-sales.com

CALL OR WRITE FOR OUR **FREE** 64 PAGE CATALOG!
(800) 445-3201

Digital Multimeters

Elenco Model M-1740

$19.95

11 Functions:
- Freq. to 20MHz
- Cap. to 20µF
- AC/DC Voltage
- AC/DC Current
- Beeper
- Diode Test
- Transistor Test
- Meets UL-1244 safety specs.

Elenco Model LCR-1810

$89.95

- Cap. 0.1pF to 20µF
- Inductance 1µH to 20H
- Resistance 0.01Ω to 2,000MΩ
- Temperature -20°C to 750°C
- DC Volts 0 - 20V
- Freq. up to 15MHz
- Diode/Audible Continuity Test
- Signal Output Function
- 3 1/2 Digit Display

Elenco Model LCM-1950

$65

- Large 1" 3 3/4 Digit LCD
- Autoranging Freq. to 4MHz
- Cap. to 400µF
- Inductance to 40H
- Res. to 4,000MΩ
- Logic Test
- Diode & Transistor Test
- Audible Continuity Test

LCR Bridge

B&K Model 878

$229

- Accurately measures capacitance, resistance, and inductance.
- Measures dissipation factor of capacitors and Q of inductors.
- Simultaneously displays measures, value, and Q or dissipation factor.

Deluxe Soldering Stations

Elenco SL-5 Series

Electronically controlled, ideal for professionals, students, and hobbyists. Available in kit form or assembled.

Works w/ any iron! Turn any soldering iron into a variable iron.

As Low As **$24.95**

Features:
- Cushion Grip Handle Soldering Iron (optional) with Grounded Tip for Soldering Static-Sensitive Devices. Easily Replaceable. Uses Long-Life, Plated Conical Tip.
- Heavy Steel, Non-Slip Base.
- Iron Holder Funnel - Reversible, left or right side.
- Steel Tray for Sponge Pad.
- Sponge Pad.

Quantity Discounts Available

Ordering Information:

Model SL-5 - No iron. (Kit SL-5K) **$24.95**

Model SL-5-40 - Includes 40W UL iron. (Kit SL-5K-40) **$29.95**

Test Equipment

Elenco Four Functions in One Instrument Model MX-9300B

Features:
- One instrument with four test and measuring systems:
  - 1.3GHz Frequency Counter
  - 2MHz Sweep Function Generator
  - Digital Multimeter
  - Digital Triple Power Supply

$450

Elenco 3MHz Sweep Function Generator with built-in 60MHz Frequency Counter Model GF-8046

$199.95

Generates square, triangle, and sine waveforms, and TTL CMOS pulse.

GF-8025 - Without Counter **$139.95**

20MHz Sweep / Function Generator with Frequency Counter Model 4040A

- 0.2Hz to 20MHz
- AM & FM Modulation
- Burst Operation
- External Frequency Counter to 30MHz
- Linear and Log Sweep

10MHz Model 4017A	$325	$445
5MHz Model 4011A	$259	
2MHz Model 4010A	$225	BK PRECISION

Elenco Handheld Universal Counter 1MHz - 2.8GHz Model F-2800

$99

Sensitivity:
- <1.5mV @ 100MHz
- <5mV @ 250MHz
- <5mV @ 1GHz
- <100mV @ 2.4GHz

Features 10 digit display, 16 segment and RF signal strength bargraph.

Includes antenna, NiCad battery, and AC adapter.

C-2800 Case w/ Belt Clip.....**$14.95**

Elenco RF Generator with Counter (100kHz - 150MHz) Model SG-9500

$225

Features internal AM mod. of 1kHz, RF output 100MV - 35MHz. Audio output 1kHz @ 1V RMS.

SG-9000 (analog, w/o counter) **$119**

Elenco Quad Power Supply Model XP-581

4 Fully Regulated Power Supplies in 1 Unit

$75

4 DC Voltages: *3 fixed;* +5V @ 3A, +12V @ 1A, *1 variable;* 2.5 - 20V @ 2A • Fully Regulated & Short Protected • Voltage & Current Meters • All Metal Case

Elenco Power Supply Model XP-603

$75

- 0-30VDC @ 3A Output
- 3A Fused Current Protection
- Current Limiting Short Protection
- 0.025Ω Output Impedance

Elenco 10Hz - 1MHz Digital Audio Generator Model SG-9300

$225

Features built-in 150MHz frequency counter, low distortion and sine/square waves.

SG-9200 (w/o counter) **$119**

Elenco Model SL-30

$79.95

- Tip temperature changeable from 300°F (150°C) to 900°F (480°C).
- Temperature is maintained within +10°F of its preset temperature.
- The tip is isolated from the AC line by a 24V transformer.
- The tip is grounded to eliminate static charges.

SL-10 - Same as SL-30 w/o digital display **$59.95**

Weller® Low Cost Soldering Iron Model WLC100

- Variable power control produces 5-40 watts.
- Ideal for hobbyists, DIYers and students.
- Complete with 40W iron.

$54.95

Elenco Oscilloscopes

Free Dust Cover and 2 Probes

S-1325 25MHz Dual Trace	$325	**S-1345** 40MHz Delayed Sweep	$549
S-1330 25MHz Delayed Sweep	$439	**S-1360** 60MHz Delayed Sweep	$725
S-1340 40MHz Dual Trace	$475	**S-1390** 100MHz Delayed Sweep	$895

Deluxe 29pc. Computer Service Tool Kit

$36.95 Elenco Model TK-1200

Includes Soldering Iron, Solder, Long Nose Pliers, Diagonal Pliers, 11 pc. Screwdriver Bit Set, Wire Stripper, IC Inserter, IC Extractor, Screwdriver, Phillips Screwdriver, Desoldering Pump, and more!

Elenco Educational Kits

Model XK-150

Digital / Analog Trainer

$89.95

- **830-pin Breadboard**
- **8 Data Switches**
- **8 LED Buffered Readouts**
- **Built-in Function Generator** (sine and square wave)
- **Built-in Clock Generator**
- **Variable Power Supply** +1.25V to 15VDC @ .25A -1.25V to -15VDC @ .25A +5VDC @ .25A +30VAC center-tapped at 15VAC @ .25A

OWI Model OWI-007

Robotic Arm Trainer

$82.50

Model AM-780K

Two IC Radio Kit

$9.95

Model AK-700

Pulse/Tone Telephone Kit
Flashing Neon Lights
Great School Project

$14.95

Model RCC-7K

Radio Control Car Kit

$27.95

- 7 Functions
- Transmitter Included

Model M-1005K

DMM Kit

- Transistor Test
- Diode Test
- Overload Protection
- Pocket Size

$18.95

Model K4001

7W Amplifier

$12.95

Electronic Science Lab

Maxitronix 500-in-1 Electronic Project Lab Model MX-909

Everything you need to build 500 exciting electronic projects:
- Learn the basics of electronics. 500 different electronic experiments, special lighting effects, radio transmitter and receivers, sound effects, cool games and *MORE*!
- Includes built-in breadboard and an LCD.
- Explore amplifiers, analog and digital circuits plus how to read schematic diagrams.
- Includes 11 parts.
- Lab-style manual included.
- Requires 6 "AA" batteries.

MX-908 - 300-in-1 Lab	$59.95	
MX-907 - 200-in-1 Lab	$44.95	
MX-906 - 130-in-1 Lab	$29.95	
EP-50 - 50-in-1 Lab	$18.95	

$149

Guaranteed Lowest Prices

UPS SHIPPING: 48 STATES 5% (Minimum $5.00)
OTHERS CALL FOR DETAILS
IL Residents add 8.25% Sales Tax

SEE US ON THE WEB → **http://www.cs-sales.com**

C&S SALES, INC.

150 W. CARPENTER AVENUE
WHEELING, IL 60090
FAX: (847) 541-9904 (847) 541-0710

VISA MasterCard DISCOVER

15 DAY MONEY BACK GUARANTEE

2 YEAR FACTORY WARRANTY

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

Events Calendar

The Events Calendar is a free service for publicizing electronic events such as amateur radio hamfests, flea markets, etc. If your organization is sponsoring an event and would like a free listing, contact us at least 60 days in advance. Include your flyer, estimated attendance, name of the person to contact, and phone number.
While we strive for accuracy in our calendar, we can not be responsible for errors or cancellations. The information contained in this column is for the use of the readers of *Nuts & Volts* and may not be republished in any form without the written permission of T & L Publications, Inc.

All listing information should be sent to:
Nuts & Volts Magazine
Events Calendar
430 Princeland Court
Corona, CA 92879
Phone 909-371-8497
Fax 909-371-3052
E-mail
events@nutsvolts.com

APR-JUL

APRIL 2002

APRIL 6

AR - FORT SMITH - Hamfest. Fort Smith Area ARC, 501-996-6511. Email: kc5jby@arrl.net Web: www.fsaarc.org
IN - COLUMBUS - Hamfest. Bartholomew County 4H Fairgrounds, Community Bldg., St. Rd. 11, SW. Columbus ARC, 812-342-4670.
Email: carc_in@yahoo.com
KY - ELIZABETHTOWN - Hamfest. Lincoln Trail ARC, 270-351-4721. Email: n4tfk@qsl.net

APRIL 6-7

MD - TIMONIUM - Greater Baltimore Hamboree. Baltimore ARC, 410-426-3378. Email: w3ft@juno.com Web: http://gbhc.org
WA - YAKIMA - State Convention. Yakima ARC, 509-249-0897. Email: n7kno@arrl.net Web: http://eagle.ykm.com/~w7aq/hamfest.html

APRIL 13

MN - ST. PAUL - Hamfest. Robbinsdale ARC, 763-537-1722. Email: k0ltc@visi.com Web: http://www.visi.com/~k0ltc
NJ - WEST ORANGE - Hamfest. West Orange High School, 600 Pleasant Valley Way. Roseland Radio Club, 973-994-0637. Web: www.qsl.net/k2gq
NY - NEWARK - Hamfest. Drumlin ARC, 315-597-2192. Email: wa2sok@rochester.rr.com Web: www.drumlinsarc.com
OH - GARFIELD HEIGHTS - Hamfest. 216-663-3258. Email: ln4js@visn.net
TX - BELTON - Hamfest. Bell County Expo Center. Temple ARC, Email: hamexpo@tarc.org Web: www.tarc.org

APRIL 14

CT - SOUTHINGTON - Hamfest. Southington ARA, 860-628-9346. Email: KA1ILH@chetbacon.com www.chetbacon.com/sara.htm
NC - RALEIGH - State Convention. Jim Graham Bldg., NCS Fairgrounds. Raleigh ARS, 919-872-6555.
Email: k4hf@arrl.net
Web: www.rars.org/hamfest
WI - STOUGHTON - Hamfest. Mandt Community South 4th St. Madison Area Repeater Assn., 608-245-8890.
Email: n9vwh@arrl.net
Web: http://www.qsl.net/mara

APRIL 20

FL - CORAL GABLES - Hamfest. Physics Parking Lot. Flamingo/University of Miami ARC, 305-264-4465.
Email: wa4tej@beethoven.com
FL - TAMPA - Hamfest. TARC, email: k4law@arrl.net Web: www.hamclub.org
ME - SOUTH PORTLAND - Hamfest. Greater Portland Electronics Flea Market, Portland Amateur Wireless Assn., 207-799-1116. Email: k1gax@arrl.net Web: www.digilogic.com/pawabra/pawa/pawa.htm
NC - MORGANTON - Hamfest. Catawba Valley Hamfest Committee, 828-205-8335.
Email: kc4qpr@vistatech.net
http://cvhamfest.linuxham.org
VA - CHESAPEAKE - Hamfest. Chesapeake AR Service, 757-583-1703. Email: ruthis23505@yahoo.com Web: www.qsl.net/cars

APRIL 20-21

CA - PALO CEDRO - EMCOMM Convention. Sacramento Valley Section ARES, 530-396-2256.
Email: k6bz@arrl.org
Web: www.qsl.net/k6soj/

APRIL 21

MA - CAMBRIDGE - Hamfest. MIT Radio Society/Harvard Wireless Club/MIT UHF Repeater Assn., Email: w1gsl@mit.edu (617-253-3776 9am-5pm.)
Web: http://web.mit.edu/w1mx/www/swapfest.html
PA - WASHINGTON - Hamfest. WACOM, 724-228-0546.
Email: jbur@mlynk.com

APRIL 26-27

AR - LITTLE ROCK - Hamfest. Little Rock Expo Center, Exit 126, I30.
Web: www.aristotle.net/~hamfest
TN - OAK RIDGE - Conference. Garden Plaza Hotel. Southeastern VHF Society, 865-481-2468. Web: www.svhfs.org

APRIL 27

CA - SONOMA - Hamfest. Sonoma Valley Veteran's Memorial Bldg., 126 First St. W. Valley of the Moon ARC, 707-996-4494
FL - GAINESVILLE - Alachua County Fairgrounds, 3400 NE 39th Ave., SR222. GARS, 352-378-0512. Email: k4hfj@arrl.net Web: www.gars.net/hamfest
MO - KANSAS CITY - Hambash. Ararat Shrine, 5100 Ararat Dr. Ararat Amateur Radio

COMPUTER SHOWS

AGI Shows, 317-299-8827
E-Mail: info@agishows.com
http://www.agishows.com

Blue Star Productions
612-788-1901
www.supercomputersale.com

Computers And You
734-283-1754
www.a1-supercomputersales.com

Computer Central Shows
630-782-4625
Fax 630-834-2594
E-Mail: cc@gats.com
www.computercentralshows.com

Computer Country Expo
847-662-0811
Web: www.ccxpo.com

Five Star Productions
810-379-3333
E-Mail: jeff@fivestar
www.fivestarshows.com

Gibraltar Trade Center, Inc.
734-287-2000 Taylor, MI
E-Mail: taylor@gibraltartrade.com
www.gibraltartrade.com

Gibraltar Trade Center, Inc.
810-465-6440 Mt. Clemens, MI.
E-Mail:
mtclemens@gibraltartrade.com
www.gibraltartrade.com

KGP Productions
1-800-631-0062, 732-297-2526
E-Mail: kgp@mail.com

MarketPro, Inc., 201-825-2229
www.marketpro.com

MarketPro, Inc., 301-984-0880
E-Mail: md@marketpro.com
http://marketpro.com

ComputerShow
770-663-0983
E-Mail: narisaam@aol.com
Web: www.shownsale.com

Northern Computer Shows
978-744-8440
E-Mail: inquiries@ncshows.com
Web: ncshows.com

Peter Trapp Computer Shows
603-272-5008
Web: www.petertrapp.com

Shrine Club, 816-941-3392. Email: sdowdy@kc.rr.com
OR - EUGENE - Hamfest. Up The Crick Radio Club, Email: mikea@efn.org Web: www.w7utc.net
PA - YORK - Hamfest. York County School of Tech, 2179 S. Queen St. York Hamfest Foundation, 301-620-0270. Email: banderso@eni.net
SC - WINDSOR - Hamfest. Salkehatchie ARS, 803-245-4673. Email: af4qz@arrl.net Web: www.qsl.net/kf4cvo

APRIL 28

DE - NEW CASTLE - Convention. Nur Temple, Rt. 13 N. Penn-Del ARC, 302-793-1080. Email: hfrantz@snip.net Web: www.high-techservices.com/penndel
IL - ARTHUR - Hamfest. Moultrie/Douglas County Fairgrounds. Moultrie ARK, 217-543-2178 days or 217-873-5287 eves. Email: rzancha@one-eleven.net
OH - ATHENS - Hamfest. Athens Community Recreation Center. ACARA, email: ka7jxg@callsign.net Web: www.fhradio.org
OH - CANFIELD - Hamfest. Mahoning County Career and Technical Center, 7300 N. Palmyra Rd. Twenty Over Nine ARC, 330-793-7072. Email: n8lne@arrl.net

MAY 2002

MAY 3-4

MO - LEBANON - State Convention. Lebanon ARC, 417-532-4642. Email: bwheeler@advertisnet.com
NH - HOPKINTON - Hamfest. Hosstraders, email: k1rqg@aol.com

MAY 4

AZ - SIERRA VISTA - Hamfest. Cochise ARA, 520-336-5216. Email: mcnab@c2i2.com Web: www.qsl.net/k7rdg
KY - LOUISA - Hamfest. Big Sandy ARC, 606-638-9049. Email: wa4swf@arrl.net Web: http://www.bsarc.org
NY - OWEGO - Hamfest. Binghamton ARA, 607-748-5232. Email: n2bc@arrl.net
SC - SPARTANBURG - Hamfest. Blue Ridge ARS, 864-833-2204. Email: w4rgw@arrl.net Web: www.brars.org
WI - CEDARBURG - Hamfest. Ozaukee RC, 262-377-6792. Web: http://www.qsl.net/orc

MAY 4-5

AL - BIRMINGHAM - Hamfest. Birmingham ARC, 205-681-5019. Email: ke4yzk@bellsouth.net Web: http://www.w4cue.com
NJ - EDISON - Trenton Computer Festival. Raritan Center, Rt. 514 NJ Tpke., Exit 10. KGP Productions, 1-800-631-0062. Email: kgp@mail.com Web: www.tcfshow.com/
TX - ABILENE - Hamfest. Abilene Civic Center. Key City ARC, 915-672-8889. Email: ka4upa@arrl.net

MAY 5

IL - SANDWICH - Hamfest. Sandwich Fairgrounds. KARC, 815-895-3310. Email: bob@w9icu.com Web: http://www.qsl.net/wa9cjn
PA - WRIGHTSTOWN (BUCKS COUNTY) - Hamfest. Warminster ARC, 215-822-0749.

Tired of Expensive Inkjet Cartridges?

Save 90% on Inkjet Inks !

Refill kits Black (8 oz) Color (4 oz C, Y, M) Printer (Call for Others Not Listed!)	# of Refills Black	Color	Cost/Refill Black	Color	Kit Price Black	Color
HP500 Series, 400, Officejet 300, 350, Fax	7	14	**4.71**	**2.85**	32.95	39.95
HP600 Series, Officejet 500, 570, 600, 610 630, 700	7	14	**4.71**	**3.21**	32.95	44.95
HP820C, 855C, 870C, 1000C, 1150C, Copier 120, 210	6	12	**6.67**	**3.33**	39.95	39.95
HP720C, 722C, 712C, 880C, 890C, 895C, 1120C, 1170C	6	12	**6.67**	**3.75**	39.95	44.95
HP900C Series, P1000 Series, Officejet G55, G85, G95	6	12	**6.67**	**3.75**	39.95	44.95
HP2000C Pro Color Printer, 2200, 2500	6	12	**6.67**	**3.75**	39.95	44.95
Canon BJ-10, 200, 210, 240, 250 Apple StyleWriter 1200,1500	14	20	**2.15**	**2.00**	29.95	39.95
Canon BJC-4000 Series, 2000, 5000 Series, Multipass Series	60	60	**0.50**	**0.67**	29.95	39.95
Canon BJC-6000, 3000, S400, S450, S600, Multipass 755	14	8	**2.85**	**1.67**	39.95	39.95
Epson Stylus Color 500, 200	20	17	**1.50**	**2.35**	29.95	39.95
Epson Stylus Color 400, 600, 800, 850, 1520, Photo	20	17	**1.50**	**2.65**	29.95	44.95
Epson Stylus Color 440, 660, 670, 740, 760, 860	20	17	**1.50**	**2.65**	29.95	44.95
Epson Stylus Color 480, 580, 880 **NEW**	20	17	**1.50**	**2.65**	29.95	44.95
Lexmark 3200, 5700, Z11, Z12, Z31, Z32, Compaq IJ300, IJ600, IJ700, IJ750, IJ900 Xerox XJ8C	15	17	**2.67**	**2.35**	39.95	39.95
Lexmark Z42, Z51, Z52, Z83, Compaq IJ1200, A1000 **NEW**	15	17	**2.67**	**2.65**	39.95	44.95
Lexmark Photo kit for 3200, 5700, 7000, 7200, Z42, Z51, Z52		9		**3.11**		27.95
Lexmark 2030, 2050, Execjet II/IIc, Medley 4C, Compaq IJ200	10	17	**3.00**	**2.35**	29.95	39.95
Xerox HC 450, XJ4C, XJ6C	22	12	**1.36**	**3.33**	29.95	39.95
New Combination Kits Black dye 4 oz / Color 2 oz each					**44.95**	
New Combination Kits Black pigmented 4 oz / Color 2 oz each					**49.95**	

Save 30 - 60% on New Compatible Cartridges
Quantity Discounts for 3 or 6+ cartridges Mix and match

Printer (Call for Others Not Listed!)	BLACK Cartridge Qty 1 / 3 / 6+	COLOR Cartridge Qty 1 / 3 / 6+
Canon BJC-4000 Series, 2000, 5000 Series, Multipass Series	**4.50 / 3.83 / 3.69**	**10.95 / 9.31 / 8.98**
Canon BJC-6000, 3000, S400, S450, S600, Multipass 755	**7.95 / 6.76 / 6.52**	**7.50 / 6.38 / 6.15**
Canon BJC-70, 80, 85 (3 pack Black / 3 pack color)	**9.95 / 8.46 / 8.16**	**14.95 / 12.71 / 12.26**
Epson Stylus Color, Color Pro, Pro XL	**9.95 / 8.46 / 8.16**	**13.95 / 11.86 / 11.44**
Epson Stylus Color II, IIs, 200	**9.95 / 8.46 / 8.16**	**13.95 / 11.86 / 11.44**
Epson Stylus Color 400, 500, 600, 800, 850, 1520, Photo	**9.95 / 8.46 / 8.16**	**13.95 / 11.86 / 11.44**
Epson Stylus Color 440, 660, 670, 740, 760, 860	**9.95 / 8.46 / 8.16**	**13.95 / 11.86 / 11.44**
Epson Stylus Color 750, 900, 980, 1200	**10.95 / 9.31 / 8.98**	**15.95 / 13.51 / 13.08**
Epson Stylus Color 480, 580, 880 **NEW**	**10.95 / 9.31 / 8.98**	**14.95 / 12.71 / 12.26**
Epson Stylus Color 777, 870, 875, 1270 **Requires Empty Return !**	**11.95 / 11.95 / 11.95**	**15.95 / 15.95 / 15.95**

Quality Inks and Toners for:
HP Epson Lexmark
Canon Apple Xerox

New Combination Black / Color Kits
4 oz black dye / 2 oz C,M,Y color - **$44.95**
4 oz black pigmented / 2 oz C,M,Y - **$49.95**

Mon - Fri 8:30-5:30 PDT 11:30-8:30 EST

Call or see us online!

Inkjet Southwest

VISA

www.inkjetsw.com
(480) 668-1069 Fax

1-800-447-3469
(480) 668-0959

Circle #40 on the Reader Service Card.

Events Calendar

Email: k3zma@aol.com Web: http://www.k3dn.org

MAY 11

NV - RENO - Hamfest. Reno Area Metro Simplex, 775-673-6401. Email: glen@kk7ih.net Web: www.nvrams.org
PA - FREDERICKSBURG - Hamfest. AARG, 717-534-2945. Email: info@aa3rg.net Web: www.aa3rg.org
WA - STANWOOD - Hamfest. Stanwood-Camano ARC, 360-629-2921. Email: huppert@whidbey.net

MAY 17-18-19

OH - DAYTON - Hamvention. Hara Arena. Dayton ARA, general information call 937-276-6930, email: info@hamvention.org Web: www.hamvention.org/

MAY 19

MA - CAMBRIDGE - Hamfest. MIT Radio Society/Harvard Wireless Club/MIT UHF Repeater Assn., email: w1gsl@mit.edu (617-253-3776 9am-5pm.) Web: http://web.mit.edu/w1mx/www/swapfest.html

MAY 26

MD - WEST FRIENDSHIP - Hamfest. Howard Co. Fairgrounds. MFMA, 410-923-3829
OH - HILLIARD - Hamfest. Franklin County Fairgrounds. 614-267-7779. Email: clind2@juno.com

MAY 31, JUNE 1-2

NY - ROCHESTER (HENRIETTA) - Convention. Rochester ARA, 716-424-7184. Email: harold@rochesterhamfest.org Web: www.rochesterhamfest.org
OR - SEASIDE - Convention. Seaside Convention Center. SEAPAC, 503-297-1175. Web: www.seapac.org

JUNE 2002

JUNE 1

IL - SPRINGFIELD - Hamfest. Sangamon Valley RC, 217-628-3697. Email: egaffney@family-net.net
GA - MARIETTA - Hamfest. Jim Miller Park. Atlanta RC, 770-995-6446, johnka4vqh@aol.com Web: www.saf.com/arc/atlfest.htm
MI - GRAND RAPIDS - Hamfest. Hudsonville Fairgrounds. Independent Repeater Assn., Inc., 616-698-6627 after 4pm EST. Web: www.w8hvg.org

JUNE 2

IL - PRINCETON - Hamfest. Starved Rock RC, 815-433-2117. Email: bk9vzh_gov@yahoo.com
PA - PITTSBURGH (BUTLER) - Hamfest. Breezeshooters ARC, 412-221-3806. Email: n3ue@arrl.net Web: http://www.breezeshooters.net
VA - MANASSAS - Hamfest. Ole Virginia Hams ARC, 703-335-9139. Email: n4yic@arrl.net Web: http://www.qsl.net/olevahams

JUNE 7-8

MS - PASCAGOULA - Hamfest. Jackson County Fairgrounds Civic Center. Jackson County ARC, 228-826-5095. Email: nn5af@arr.net Web: www.angelfire.com/ms3/jcarc

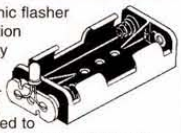
Continued on page 57

ALL ELECTRONICS CORPORATION

QUALITY Parts
FAST Shipping
DISCOUNT Pricing

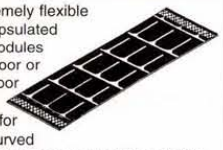
CALL, WRITE, FAX or E-MAIL For A Free 96 Page CATALOG.
Outside the U.S.A. send $3.00 postage.

Cheap LED Flasher



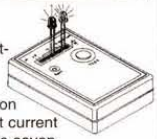
The simplest electronic flasher ever. Great for attention getting displays, party decorations, night time warning signals. A red 5mm LED with flasher chip is attached to a battery snap that snaps onto a 2 AA cell battery holder. Will flash for months on a set of batteries. Flash rate, approximately 120 flashes per minute. Batteries not included.
CAT# FSH-10 $1.00 each
100 for 70¢ each
500 for 60¢ each
1000 for 50¢ each

Flexible Thin Film Solar Panels



Very thin, extremely flexible polyester encapsulated photovoltaic modules suitable for indoor or protected outdoor use. Lightweight. Great for mounting on curved surfaces. Ideal for charging nickel cadmium and nickel metal hydride batteries or running low current applications. Can be connected in series or parallel for higher voltage or current. Modules have copper strips at each end to make solder connections.
CAT # SPL-314 $4.50 each
3 Volts @ 19 mA 4.5" x 1.44"
CAT # SPL-328 $8.50 each
3 Volts @ 38 mA 4.5" x 2.88"

LED Tester



Pocket-size led tester. Makes it easy to check functionality, color, brightness and uniformity. Plug anyleaded LED into one of 12 positions on the socket strip to test at current ratings from 2-50ma. The seven middle positions on the strip are set at 10 mA allowing comparison of LEDs in those spaces. Requires 9 v battery (not included).
CAT# LT-100 $8.95 each

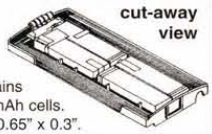
Lithium Battery CR123A

Tekcell CR123A. 3 Volt lithium cell. Commonly used in photographic equipment. 1.34" long x 0.65" diameter.
CAT# LBAT-123 $2.85 each
10 for $2.60 each
100 for $2.35 each
800 for $1.90 each

Humidity Meter

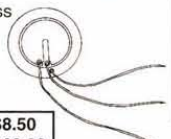
Duracraft. Relative humidity scale calibrated from 20% to 100%, with 30% to 50% being designated the "Comfort Zone." 2" diameter meter in a wall-mount or table-top gray plastic case, 3.55" high x 2.66" wide x 1.18" deep.
CAT# HMR-1 $2.50 each

Nickel-Metal Hydride 4.8V 850 mAH Battery Pack



Philips # 25733. New, rechargeable pack manufactured for cell phones. Contains four 1.2 Volt, 850 mAh cells. Each cell is 1.8" x 0.65" x 0.3". With little effort you can remove the cells from the enclosed battery pack and reconfigure them to suit your needs. **CAT# NMH-53**
$2.00 each
10 for $17.50

1.38" Piezo Disc

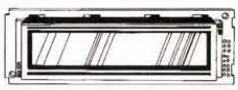


Kyocera. 35mm brass piezo element with exciter circuit. Three 2" wire leads.
CAT# PE-44 $1.00 each
10 for $8.50
100 for $60.00

Great Price! 60 Watt Switching Power Supply

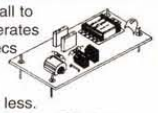
Autec # UPS61-1004-T Input: 115/230 Vac Outputs: 3.3V @ 4A, 5 V @ 2A, 12V @ 3A, 32V @ 5 mA. New, open-frame switching supply. 5" x 3.46" x 1.68." "Panasonic-type" two conductor receptacle for AC input, can be hardwired if desired. Fused input. 10 conductor molex-type plug output. Ferrite bead for EMI suppression on output wires. Large quantity available.
CAT # PS-70 $4.50 each
case of 48 pieces for $3.50 each

16 Character X 2 Line LCD with LED Backlight



Alesis Corp. G8 LCD 16 x 2 LCD. Module size: 4.85" x 1.7." Display size: 3.67" x 1.05." Black bezel around the display, 4" x 1.46." Input through 16 pin male header, 2 x 8 pins on 0.1" centers. LED backlight operates on 5 Vdc. No spec or hook-up sheet available.
CAT # LCD-68 $5.00 each

Inverter, 5 Vdc Input



TDK-2090. Inverter for small to medium CCFT lamps. Operates on 3-5 Vdc. No official specs available at this time. Our tests indicate that it lights lamps of 250mm length or less. Module is 2.17" x 1.1" x 0.4" high. PC pins on 2" x 0.84" centers. Large quantity available. **CAT# INV-7** $5.00 each

CCFT Lamp 3.2mm X 250mm

3.2 mm diameter X 250 mm long. White. JKL BF3250-20B. **CAT # BF-3250**
$7.50 each
100 for $6.00 each

ORDER TOLL FREE 1-800-826-5432
Shop ON-LINE www.allelectronics.com

MAIL ORDERS TO:
ALL ELECTRONICS CORP.
P.O. BOX 567 • VAN NUYS, CA 91408-0567

FAX (818) 781-2653 • INFO (818) 904-0524
E-MAIL allcorp@allcorp.com

NO MINIMUM ORDER • All Orders Can Be Charged to Visa, Mastercard, American Express or Discover • Checks and Money Orders Accepted by Mail • Orders Delivered in the State of California must include California State Sales Tax • NO C.O.D • Shipping and Handling $6.00 for the 48 Continental United States - ALL OTHERS including Alaska, Hawaii, P.R. and Canada Must Pay Full Shipping • Quantities Limited • Prices Subject to change without notice.

MANUFACTURERS - We Purchase EXCESS INVENTORIES... Call, Write, E-MAIL or Fax YOUR LIST.

Circle #41 on the Reader Service Card.

by Jon Williams

Stamp Applications

Sonic Sight-Seeing With Sound

Several months back, Bill Boyer, a DPRG club member — an experienced BASIC Stamp user — demonstrated the Devantech SRF04 ultrasonic range finder. Bill did some really neat things with it. His robot is able to scan an area and locate a target as narrow as a broom stick. I've used IR object detection for avoidance, but it's not really suitable for object location. I had to try the SRF04.

By now, many of you know that I live in Dallas and really love the city. For a wanna-be geek, it's a great place to live in with so many technology companies located here. Where this helps a regular guy like me is when geeks [and I mean that in the best way] gather. My favorite local gathering of geeks is the Dallas Personal Robotics Group.

The DPRG is one of the bigger robotics clubs in the country. We have members from very young to very ... uh, "mature" (that's you, Ralph) — male and female. The diversity of the DPRG's membership is a real strength, and no matter what a person's experience level, the DPRG has something to offer.

One of my favorite aspects of club meetings is "show and tell." Members are allowed to show off their handiwork, whether it be hardware, software, a mix of both, or just some bolt-out-of-the-blue idea. Everything is enthusiastically welcomed by the club.

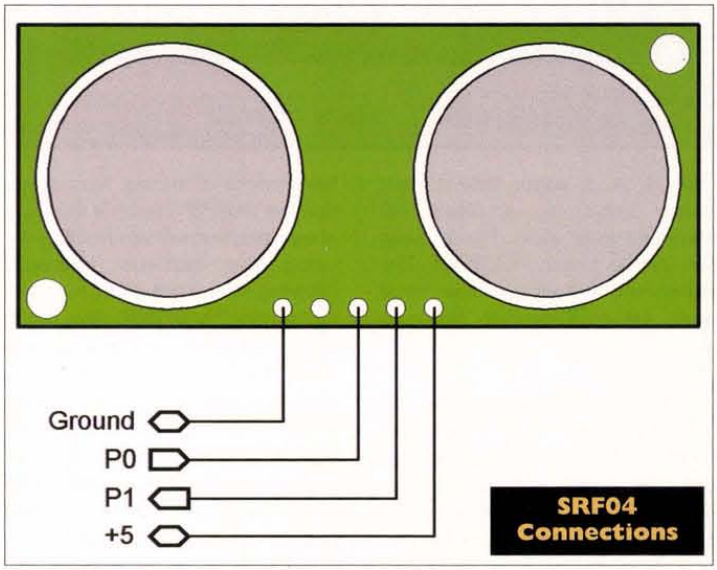
Several months back, club member Bill Boyer — an experienced BASIC Stamp user — demonstrated the Devantech SRF04 ultrasonic range finder. Bill did some really neat things with it. His robot is able to scan an area and locate a target as narrow as a broom stick. I've used IR object detection for avoidance, but it's not really suitable for object location. I had to try the SRF04.

Well, it took a while, but I finally called Acroname (see sources) and ordered a sensor. It arrived a few days later, complete with documentation that included a demo program for the BS2. We'll expand on that program here.

Blind Like A Bat

I find it interesting that we refer to bats as blind. I grew up in the desert of southern California and used to play a game with the local bats: dodge this rock. When the bats would come out in the early evening, I would casually toss a small stone into their flight path. With amazing dexterity and precision, the bats would avoid the rock and continue on their quest for insects. Clearly, bats aren't blind; even if their eyes don't work particularly well. (Note: No bats were ever harmed in the course of my little game.)

The SRF04 "sees" the same way a bat does — by emitting a short burst of sound and "listening" for the echo. Under control of the Stamp (or other micro), the SRF04 emits an ultrasonic (40 kHz) sound pulse. This pulse travels through the air at about 0.9 feet per second (the speed of sound), hits something, and then bounces back. By measuring the time between the transmission of the pulse and the echo return, the distance to the object can be determined.

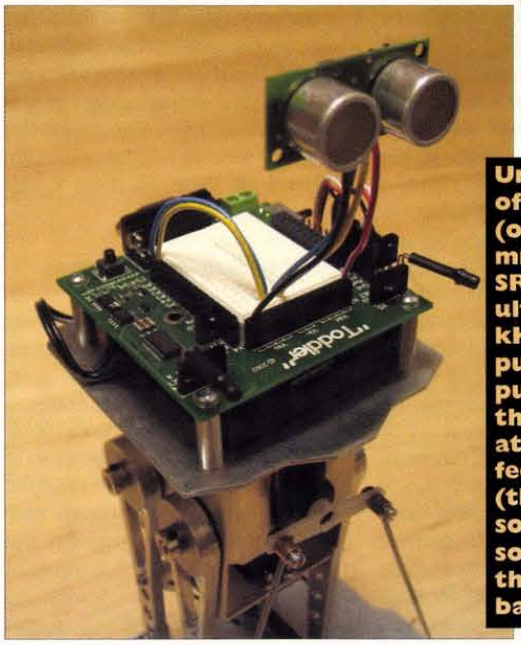


SRF04 Connections

The SRF04 outputs a high-going pulse that corresponds to the time required for the echo to return. We can, of course, use PULSIN to measure it and determine the distance to the target. And ... there's a convenient side-effect with PULSIN on the BS2: the value returned for the round-trip is in two microsecond units — the same as a one-way trip (sensor to target) in one microsecond units.

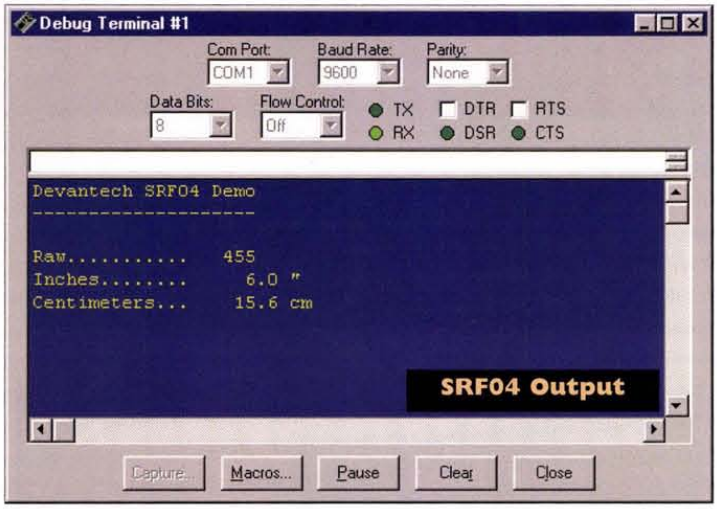
Build An Ultrasonic Tape Measure

There are a couple of small technical details to be aware of, but otherwise, coding for the



For more info on the SRF04, check out Kerry Barlow's article in this issue.

Under control of the Stamp (or other micro), the SRF04 emits an ultrasonic (40 kHz) sound pulse. This pulse travels through the air at about 0.9 feet per second (the speed of sound), hits something and then bounces back.



SRF04 is a snap. The trigger pulse must be at least 10 microseconds wide. That's easy; we can do it with PULSOUT. The other requirement is that we must wait 10 milliseconds between measurements. No problem there, either.

The heart of this program is a subroutine called Get_Sonar. This routine started with the code sample that came with the sensor. What I found, however, was that the reading seemed to bounce around a bit. I felt like a little filtering (averaging several readings together) would smooth things out and make the output more useful.

The value returned by the routine will be stored in rawDist, so the code starts by clearing it. Then, within a loop, the code takes five readings from the sensor and averages them together. This may look a bit odd because most us think about adding numbers and then dividing to get an average. We do the dividing first and then add the result into the return value because we could have an overflow if we do all the addition first. Yes, the dividing first technique can lead to rounding errors, but only if the values were very small. I have not seen this when using the sensor. Since one inch (the minimum range of the sensor) is about 74 microseconds, dividing by five (loop value) each time through causes no problem.

With the raw measurement complete, we can display it and convert it to units that make more sense to us humans. To convert the raw measurement to inches, we need to divide by 73.746. If we change this to 7.3746, then we'll have tenths of inches. Remember that we can't divide by a fractional number, but we can multiply by using the star-star operator. Dividing by 7.3746 is the same as multiplying by 0.1356 (the reciprocal). To get the star-star parameter, we multiply 0.1356 by 65,536 to get 8886 (Note: Using 8886 with star-star is actually equally to multiplying by 0.13558 — pretty darned close). The same technique is used to convert the raw value to centimeters.

To keep the display neat, I used a simplified version of Tracy Allen's right justification technique. Since the units are in tenths, the value is divided by 10 before sending to RJ_Print. On return, the decimal place is printed, then the tenths digit by using the DEC1 modifier. How's that for an easy program?

Now that I've got my SRF04 working, I'll start on the "search" routine. Maybe Bill will help me with some code ... If all goes well, my BOE-Bot will be able to locate and retrieve empty soda cans in some future DPRG Roborama. I'm a long way from that, though. When I get there, I'll share it with you.

More Robot Goodies

Our friends at Quadravox have been busy and they've come up with a couple of cool new modules that are useful for robotics.

The first is the QV316M4-TTS. This module is identical to the QV306M4 sound module, except that is does speech synthesis (male voice) through the entry of allophones. For those of you have been scratching to locate an SP0256-AL2 — forget about it. Go get a QV316M4. It has much better quality than the SP0256-AL2, an onboard amplifier, and an easy-to-use serial interface. It will buffer up to 40 allophones so that your micro isn't tied up while the unit is "talking." As I indicated a moment ago, if you're using a QV306M4 to do [pre-recorded] speech, you can pop a QV316M4 into its place and have an unlimited vocabulary.

The second new product is called the QV356M4 — the BOE-Bot Speech Board. This product was designed to mount right onto the Parallax BOE-Bot chassis. The QV356M4 combines the elements of the QV306 sound module and the QV430 programmer into one PCB; then it adds a whole host of new features.

In addition to its pre-recorded robot vocabulary, the QV356M4 can record a user message under control of the Stamp. The message is similarly played back. You can even change the sound of the prerecorded speech by changing the sampling and playback frequency. The feature that I particularly like is the ability to mix sounds generated by the Stamp (FREQOUT, DTMFOUT) through the QV356M4 amplifier. This means there's no need to record simple beeps that can be generated in code by the Stamp.

Both units are available from Parallax. Check the web site for additional details, documentation, and demo source code.

Oops...

It came to my attention that another contributor to *Nuts & Volts* suggested (in the February issue) that the BASIC Stamp is not capable of decoding and analyzing Sony IR signals. I got several calls and e-mail notes from confused readers regarding this statement.

Since I work for Parallax and have more Stamp experience than the other author, please allow me to set the record straight: the BS2sx and BS2p are great at Sony IR decoding — all 12 bits of the consumer protocol. And in case you missed it, be sure to check out my article called "Control from the Couch" that was published in this column in August 2001. The article includes IR signal analysis and complete 12-bit decoding using the BS2sx or BS2p.

Even the "elder statesman" (the stock BS2) is capable of basic IR decoding and can handle simple remote commands like channel up and down, volume control, and power on and off. We've entertained thousands of school children and trade show visitors the last couple of years with BS2-powered, IR-controlled BOE-Bots and other Parallax demos. We love IR control! Come visit us at a trade show or educational course and you'll see just how much.

Thanks for allowing me to clarify. Until next time, Happy Stamping. **NV**

Resources:

Jon Williams
jonwms@aol.com

Parallax
599 Menlo Drive, Suite 100
Rocklin, CA 95756
(888) 512-1024
www.parallaxinc.com

Acroname
www.acroname.com

Devantech
www.robot-electronics.co.uk

Dallas Personal Robotics Group
www.dprg.org

The Nuts & Volts of BASIC Stamps Volumes 1 & 2

$29.95 each

Order Both Volumes For $49.95!

"... is as much of a BASIC Stamp reference book as it is an application idea guide ..."

Call our orderline at
1 800 783-4624
Or order online from the Nuts & Volts Bookstore
www.nutsvolts.com

```
'
'=====================================================================
'
'    File..... SONIC SIGHT.BS2
'    Purpose... Devantech SRF04 Ultrasonic Range Finder
'    Author.... Jon Williams
'    E-mail.... jonwms@aol.com
'    Started...
'    Updated... 06 MAR 2002
'
'    {$STAMP BS2}
'
'
'=====================================================================


' -----[ Program Description ]---------------------------------------------------
'
' This program uses the Devantech SRF04 to measure the distance between the
' unit and a target.  Display is raw value, inches and centimeters.
'
' Conversion formulas:
'
' inches = echo_time / 73.746            (use 7.3746 for tenths)
' centimeters = echo_time / 29.033       (use 2.9033 for tenths)


' -----[ Revision History ]------------------------------------------------------


' -----[ I/O Definitions ]-------------------------------------------------------

Trigger         CON     0
Echo            CON     1


' -----[ Constants ]-------------------------------------------------------------

MoveTo          CON     2               ' cursor position control


' -----[ Variables ]-------------------------------------------------------------

pWidth          VAR     Word            ' pulse width from sensor
rawDist         VAR     Word            ' filtered measurment
distance        VAR     Word            ' converted value
blips           VAR     Nib             ' loop counter for measurement

temp            VAR     Word            ' value for RJ_print
digits          VAR     Nib             ' used by RJ_Print


' -----[ EEPROM Data ]-----------------------------------------------------------


' -----[ Initialization ]--------------------------------------------------------

Init:
  PAUSE 250
  DEBUG CLS
  DEBUG "Devantech SRF04 Demo", CR
  DEBUG "--------------------", CR, CR
  DEBUG "Raw........... ", CR
  DEBUG "Inches.......          ", 34, CR
  DEBUG "Centimeters...         cm", CR


' -----[ Program Code ]----------------------------------------------------------

Main:
  GOSUB Get_Sonar                       ' take sonar reading
  DEBUG MoveTo, 15, 3
  temp = rawDist
  GOSUB RJ_Print                        ' display raw value

  DEBUG MoveTo, 15, 4
  distance = rawDist ** 8886            ' divide by 7.3746
  temp = distance / 10
  GOSUB RJ_Print                        ' display inches
  DEBUG ".", DEC1 distance

  DEBUG MoveTo, 15, 5
  distance = rawDist ** 22572           ' divide by 2.9033
  temp = distance / 10
  GOSUB RJ_Print                        ' display centimeters
  DEBUG ".", DEC1 distance

  PAUSE 200                             ' delay between readings
  GOTO Main

  END


' -----[ Subroutines ]-----------------------------------------------------------

Get_Sonar:
  rawDist = 0
  FOR blips = 1 TO 5
    PULSOUT Trigger, 5                  ' 10 uS trigger pulse
    PULSIN Echo, 1, pWidth              ' measure distance to target
    rawDist = rawDist + (pWidth / 5)    ' simple digital filter
    PAUSE 10                            ' minimum period between pulses
  NEXT
  RETURN


RJ_Print:                               ' right justify
  digits = 5
  LOOKDOWN temp, <[0,10,100,1000,65535], digits
  DEBUG REP " "\(5 - digits), DEC temp
  RETURN
```

Bluetooth: a wireless technology that is ready for you. Are you ready for it?

by Louis E. Frenzel

Open Communication

If you are a hopeless wireless junkie like me, you have probably already heard of Bluetooth. But maybe you haven't had the time to find out more about it. Or, if you are not hooked on wireless, you may not know much about it at all. In any case, here is an overview of this hot new wireless technology that will affect you in some way in the near future.

What Is It?

Bluetooth is a low-power microwave radio system designed for cable replacement and other short-range communications applications. Bluetooth is implemented in one or two integrated circuits, so it is small enough and cheap enough to use almost anywhere wireless capability makes sense and, in some cases, in places where it doesn't make sense. And besides making wireless two-way voice or data exchanges fast and easy, Bluetooth is designed to automatically inter-network with other Bluetooth-enabled devices. Bluetooth is a neat high-tech radio technology you will be seeing more of this year and beyond.

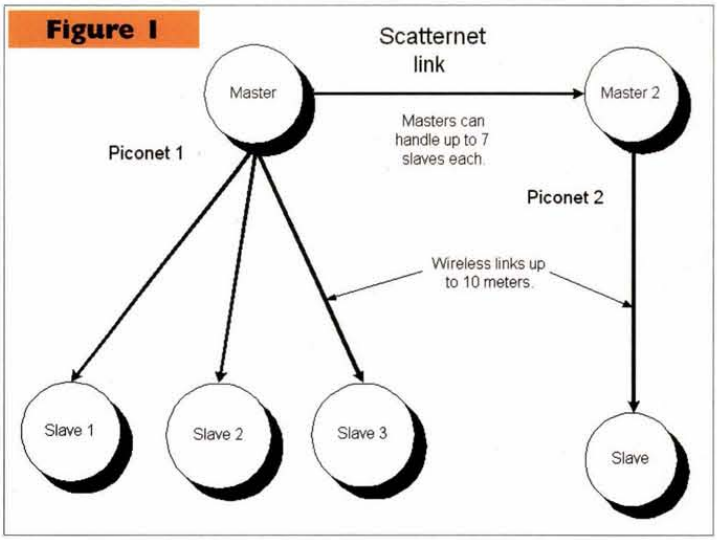
A Cable Replacement Radio. You Must Be Kidding!

Several years ago, I was involved with the design of a wireless link for sensors in an industrial application. The goal was to replace long runs of twisted pair cables from RTD temperature sensors back to the PID temperature controllers. My first reaction was "surely you jest." In my left-brain dominant engineer's mind, I reasoned that even a long piece of twisted pair has got to be cheaper than a two-way radio link.

As it turns out, twisted pair is a heck of a lot more expensive than you think, especially in a hostile industrial setting where each wire has to be installed in a metal conduit by a $75/hour union electrician. You can run up an unbelievable tab if you have to install many long (100 to 1,000 feet) runs of cable. As I proved to myself, you can actually put a simple digital radio on each sensor far cheaper than all that high-ticket cable and conduit and still have big bucks left over. I am not kidding. I can see why more engineers and electronic experimenters don't use a wireless approach. It just doesn't seem logical or possible that a wireless connection could be cheaper or easier than stringing a bunch of wires. Yet it often is, and that is even more true now that dirt-cheap (almost) Bluetooth and other wireless chips are here.

When I did this design, I actually had to invent the radios, as well as the modem and protocols. But you don't have to today. Bluetooth is a complete digital radio with all of the RF and baseband digital protocols already spelled out. In fact, Bluetooth is a formal standard as established by the Bluetooth Special Interest Group (SIG). This standard is supported by over 2,000 semiconductor and electronic equipment manufacturers. It is also covered under the IEEE's 802.15 wireless personal area networking (WPNA) standards.

Figure 1



Bluetooth was actually created as a wireless cable replacement by cell phone giant Ericsson. They were seeking a replacement for the annoying cable connecting a hands-free headset to a cell phone. With a wireless arrangement, you can actually use your headset anywhere within about 10 meters (30 feet) of your cell phone. Other cable replacements are on their way, along with dozens of other heretofore non-wireless applications now that affordable Bluetooth chip sets are available.

Tech Specs

Bluetooth radios use the license-free 2.4 GHz industrial-scientific-medical (ISM) microwave band defined under the FCC's Part 15. All data, including voice, is transmitted in digital format using frequency hopping spread spectrum (FHSS). See sidebar for more details. The modulation is Gaussian FSK, a form of FSK in which the digital data pulses are shaped by a Gaussian filter prior to modulation to help narrow their bandwidth in the radio channel. The hop rate is a fast 1,600 hops/second (625 mS interval) over 79 different frequencies from 2.402 to 2.480 GHz spaced every 1 MHz. The data rate is 1 Mbps but some of that is devoted to the protocol overhead making the peak one-way payload data rate a maximum of 723.2 kbps or 433.9 kbps symmetric two-way. Data to be transmitted is put into packets that are transmitted during each 625 mS hop period. A packet may be made up of up to five time slots. The data may be voice or any other type of information that can be put into serial digital data format.

There are three classes of

Figure 2

Bluetooth transmitters at different power levels. Class 3 uses 0 dBm (1 mW) of power for a maximum range of about 10 meters. [Note: Remember that dBm is the power in dB referenced to one milliwatt or dB = 10log (power/1 mW)]. The Class 2 transmitters use 4 dBm or 2.5 mW for a slightly extended range, while Class 1 specifies 20 dBm (100 mW) for a range up to 100 meters. That's pretty much the outer limits for most Bluetooth wireless applications, especially if it involves indoor obstacles.

While Bluetooth can be used for almost any simple one-way or two-way communications, what really makes it special is its ability to form a network with up to seven other nearby Bluetooth-enabled devices. Such networks are referred to as ad hoc or personal area networks (PANs). They allow multiple users of laptops, PDAs, or whatever to interconnect automatically and wirelessly, and exchange messages or data. The big question, what do you do with all that automatic networking capability?

How Bluetooth Works

A Bluetooth transceiver is constantly sending out a signal seeking a nearby networking partner. Should one exist within the range of the hardware, it will respond and the two units will automatically set up a communications link referred to as a piconet. One unit becomes the master and the other becomes the slave. The master unit controls the transmit and receive events. In fact, the master can actually hook up with up to seven slaves concurrently. See Figure 1. All of these units share the same bandwidth, but by using time division multiplexing, all can transmit and receive to exchange information with one another. A good example of this might be multiple laptop computers used by individuals in a meeting to pass electronic business cards, transfer files, or just chat. If two different piconets are established near one another, these two may also link up to form a scatternet. The key thing to point out here is all this networking is done automatically without user initiation or intervention. The guidelines of this inter-networking are built into the protocol.

And don't worry about security. With any wireless technology, intercept security can be a concern. Besides being secure just because of the pseudo-random hop sequence, Bluetooth has a built-in 128-bit encryption algorithm that pretty much ensures 100% privacy of communications.

Bluetooth Hardware

The first Bluetooth products were chip sets made up of a complete radio transceiver chip and a baseband chip. The only missing parts are the antenna, those components needed for filtering and impedance matching to the antenna, a quartz crystal to set the operating frequency, and those components that develop or use the data. The baseband chip implements the digital protocol and manages all of the data formatting, transmission, and reception. Today, most of the newer Bluetooth ICs are a single chip containing both the transceiver and the baseband circuits. These silicon ICs are made of 0.25 or 0.18 mm (micron) CMOS. Class 2 and 3 Bluetooth transmitters have their final power amps on chip, but if Class 1 100 mW operation is desired, a separate external power amplifier is required. These are usually made of bipolar silicon-germanimu (SiGe) or gallium arsenide (GaAs) FETs. You can also buy complete Bluetooth modules with all parts on a small PC board ready to go.

Bluetooth Applications

The first and by far most

SPREAD SPECTRUM PRIMER

Spread spectrum is a unique radio technology that spreads the radio signal out over a very wide bandwidth rather than confine it to a narrow channel as is the case in most wireless applications. See Figure A. Spread spectrum is not really new as it was discovered and patented by Hedy Lamar (the attractive movie star of old) during World War II. (I am not making this up.) Its primary use was secure military radios. Spread spectrum's primary benefit is security. Its signals are very difficult to intercept and decode, and they are virtually jam proof. Because of its secret nature and it technical complexity, spread spectrum was not really widely used until the 1980s when more information became available, the FCC allowed its use in commercial bands, and new integrated circuits made it easier to adopt. Today, spread spectrum is widely used in many wireless applications such as cordless telephones and in cell phones where it is known as CDMA (code division multiple access). It is also used in wireless data acquisition and wireless local area networks (LANs). Military and other satellites have also used it for years. And, of course, it is the basis of Bluetooth.

Figure A

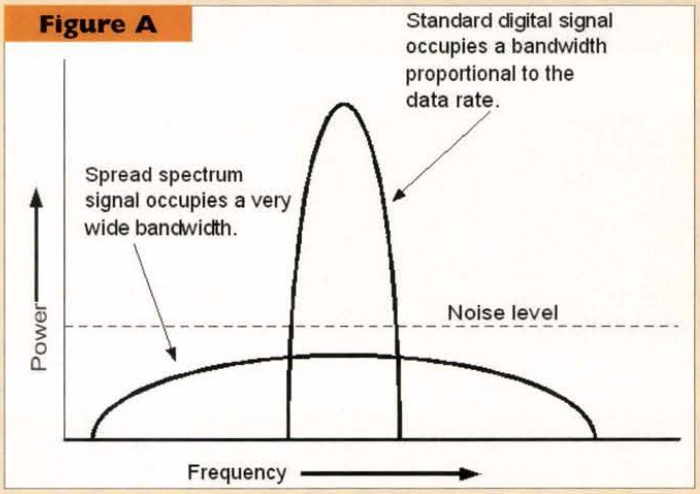
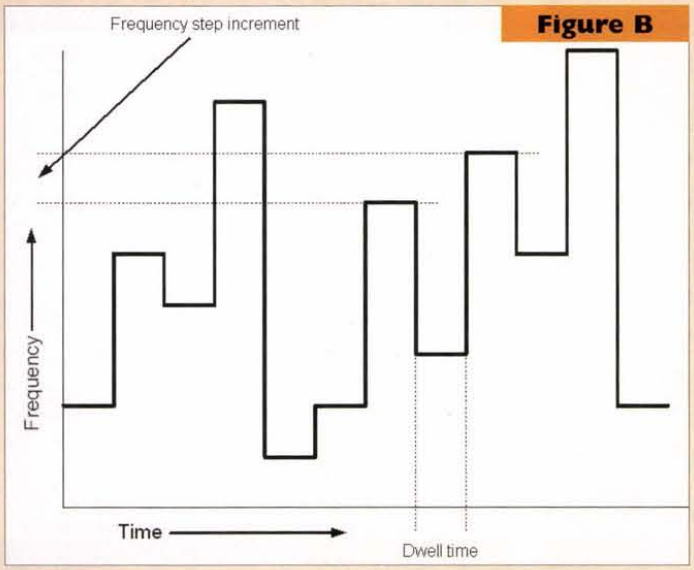


Figure B



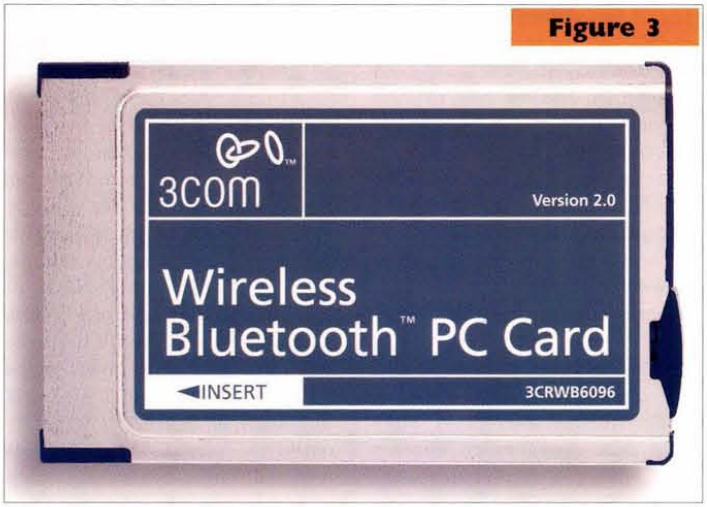
There are two basic flavors of SS: frequency hopping and direct sequence. In frequency hopping spread spectrum (FHSS), the actual frequency of operation is changed in a pseudo-random manner at a high rate of speed. This is known as the hop rate. See Figure B. The frequency remains the same for a specific short dwell period during which time data is transmitted. The result of this is that the signal energy is spread over a very wide band of frequencies.

In direct sequence spread spectrum (DSSS), the digital data to be transmitted is sent to an exclusive OR gate along with a higher frequency pseudocoded "chipping" signal. The modulation is BPSK, or some variation thereof. The result is a scrambled signal whose spectrum is very broad.

Because this technique spreads the signal over such a broad bandwidth, its average power is very low, typically below the noise level of the channel. As a result, a spread spectrum signal does not interfere with any other signal in the same band. In fact, you can actually overlay many other spread spectrum signals in the same bandwidth without them interfering with one another. For this reason, spread spectrum is also a type of multiplexing allowing many signals to share the same space. A bunch of spread spectrum signals all transmitting simultaneously just looks like a bunch of background noise to a narrow band receiver.

Besides its security and jam-resistance, SS is also more tolerant of multipath fading so common to radio communications in the UHF and microwave ranges. That makes it useful not only indoors, but also in high density urban areas for reliable communications.

Figure 3



prevalent Bluetooth product is the wireless headset. Virtually all of the big cell phone manufacturers (Nokia, Motorola, Ericsson, etc.) have several models. Another new product is the wireless printer connection. These interface devices connect to a printer parallel port or a USB port and use a Bluetooth transceiver to talk wirelessly to a nearby Bluetooth-enabled printer like Hewlett Packard's Deskjet 995c. An example is 3Com's neat 3CREB96 Bluetooth USB Adapter shown in Figure 2.

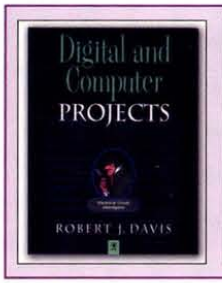
The blue-tipped antenna moves back and forth and rotates so you can position it for optimum reception. No cable is required. This is really handy as it lets you be more flexible in placing the printer with respect to the PC. And the link-up is automatic.

Bluetooth also lets you make wireless connections between laptops, PCs, and PDAs like Palm Pilots. Multiple laptops can talk to one another or a nearby PC. Or a Palm Pilot can hot-sync to a PC or a laptop. Figure 3 shows 3Com's PC card that plugs into a laptop. It uses a unique XJACK antenna that folds up and clicks back into the card when you are finished using it. An even more serious networking application is wirelessly connecting a laptop to a nearby PC LAN. Bluetooth may also be a contender in the rapidly growing home networking field.

Some manufacturers predict that a key application for Bluetooth will be Internet connectivity by a cell phone. The cell phone industry has been working on the next generation — third generation or 3G — phones which have the potential to access the Internet. But with the slow data rates, very small cell phone screens, and no keyboard, it does not seem likely.

A good alternative is to use your laptop to talk wirelessly via a Bluetooth link built into your cell phone. The cell phone connects you to your ISP while Bluetooth makes the connection from laptop to cell phone.

SolderingDesoldering.Com
Your SMD Rework Specialist
800-394-1984



New Titles added each month to the Nuts & Volts Bookstore!
See Page 26 for details!!

20 MS/s Pen-type Scope
US$ 79.–

Options
PC Software V6.0 incl. Adapter Cable 29.90
BatteryPack (to hold 9V bloc) 16.90
AC Adapter 9.90
Rubber Protection Boot. 17.90
Palm Software V2.0 incl. Adapter Cable 19.90
Active Opto-Isolating RS232 Cable 39.90
NEW
PC Software V6.0 features long term data logging, exporting data to EXCEL or text file, scrolling mode

Wittig Technologies
Wittig Technologies, Inc.
266 East Meadow Avenue
East Meadow, NY 11554
Phone (516) 794 4080, Fax (516) 794 1855
www.wittigtechnologies.com

Get Nuts & Volts delivered to your house each month and save 62% off the newsstand price!!
Order Today!
Go online at www.nutsvolts.com or call us at 1-800-783-4624

Stepper Motor Book
Easy Step'n
NEW
• For the experimenter.
• Determine surplus stepper motor specs using simple easy to build test equipment.
• Design and build microcontroller-based control systems (flow charts and code examples included).
• Design and build stepper motor driver circuits.
• Analyze the mechanical characteristics of stepper motor-driven devices.
• The book is full of experiments, circuits and code.
• 8.5x11 format. 205 pages. $34.95
Table Of Contents And Ordering Information On Web Site
http://www.stepperstuff.com

SQUARE 1 ELECTRONICS
P.O. Box 501, Kelseyville, CA 95451
Voice (707) 279-8881 Fax (707) 279-8883
We have been selling on the Internet since 1996. We will ship the day we receive your order or the next business day.

PICmicro® PIC16F87x Series and ICD Book
NEW
Easy Debug'n
• Features of PIC16F87x microcontrollers
• In-circuit debugging using Microchip ICD
• Companion for our PIC'n book series
• 8.5x11 format.
• 72 pages. $12.95
Table Of Contents And Ordering Information On Web Site
http://www.sq-1.com

PICmicro® BOOKS
LEARN ABOUT MICROCONTROLLERS
Easy PIC'n - Beginner $29.95
• Programming Techniques
Instruction set, addressing modes, bit manipulation, subroutines, loops, lookup tables, interrupts
• Using a text editor, using an assembler, using MPLAB
• Timing and counting (timer 0), interfacing, I/O conversion
PIC'n Up The Pace - Intermediate $34.95
• Serial communication - PICmicro to peripheral chips
• Serial EEPROMS
• LCD interface and scanning keypads
• D/A and A/D conversion - several methods
• Math routines
PIC'n Techniques - Intermediate $34.95
• 8-pin PICmicros
• Timer 1, timer 2 and the capture/compare/PWM (CCP) module
• Talking to a PICmicro with a PC using a terminal program
• Test equipment and data logger experiments
Serial PIC'n - Advanced $49.95
• Synchronous - bit-bang, on-chip UART, RS-232
• Asynchronous - I2C (Philips Semiconductor) SPI (Motorola), Microwire (National Semiconductor)
• Dallas Semiconductor 1-Wire bus
PICmicro and MPLAB are trademarks of Microchip Technology Inc.
Table Of Contents And Ordering Information On Web Site
http://www.sq-1.com

Some other uses include wireless connections for camcorders, digital cameras, and security systems. Connections between other consumer audio and video products such as stereos, headphones, and MP3 players are another possibility. Wireless industrial telemetry and a multitude of automotive applications are also expected.

Using Bluetooth

Yes, Bluetooth chip sets and some Bluetooth-enabled products like the wireless headset and printer connections are available today. Many others are on the way. And you may even be able to play around with some of the chip sets yourself to create wireless projects. Yet, Bluetooth in not the cheapest or easiest wireless hardware to use. You don't have to be a RF engineer to create a Bluetooth device since the chip sets leave little for you to do other than mount them, connect power and an antenna, and go. The hard part is interfacing your application to the baseband circuits. This is more of a software and programming project that requires knowing and interacting with the Bluetooth software stack. Development boards and software make this easier, but they are expensive.

As Bluetooth becomes more widely used, prices will continue to drop and development will become easier. Until then, there are many other simpler wireless options that I will talk about here in future columns.

Let me know what other communications and networking topics you would like to hear about in this space. Email me at lfrenze@attglobal.net. **NV**

Web Sites for More Information

Here is a selection of information sources about Bluetooth in case you want to learn more.

www.bluetooth.org
Official Bluetooth SIG site.

www.csr.com
Cambridge Silicon Radio, one of the first Bluetooth chip suppliers and the leading chip supplier today (Over 2 million sold!).

www.ericsson.com
Ericsson's site. Bluetooth
founder. Go to the Bluetooth section for a short tutorial.

http://grouper.ieee.org/groups/802/15/pub/Tutorials.html
IEEE's web site concerned with wireless personal area networks (WPANs) and related standards. Some tutorials there.

www.3com.com
One of the Bluetooth sponsor and pioneer companies.

www.mot.com/bluetooth/index.html
Motorola's Bluetooth site.

www.semiconductors.philips.com/technologies/bluetooth/
Philips' good site.

www.sss-mag.com
Great site for complete information on any spread spectrum technology.

http://www.webexpert.net/vasilios/telecom/telecom.htm
Good general site for info on telecommunications subjects like spread spectrum, wireless, etc.

www.PRIMECELL.com

IF YOU NEED NEW BATTERIES FOR YOUR ELECTRONIC EQUIPMENT
DON'T PITCH EM' - SEND THEM FOR REBUILDING ! - SAVE $ $

- WE INSTALL NEW NI-CAD OR NI-MH BATTERIES INTO YOUR CASE.
- WE IMPROVE PERFORMANCE TO BETTER THAN ORIGINAL.
- WE FIX WHAT CAN'T BE FOUND. (OR AFFORDED)
- WE PROVIDE QUICK SERVICE. / EXTEND LIFE OF OLDER EQUIPMENT
- WE OFFER FREE QUOTES. / FREE RETURN IF QUOTE IS REFUSED.
- WE PROPERLY DISPOSE OF YOUR OLD CELLS BY RECYCLING.
- WE GIVE YOU A 12 MONTH WARRANTY.
- WE WILL BE HERE WHEN YOU NEED US / EST. 1986
- WE SAVE YOU **** M O N E Y **** $ $ $ $

WE SERVICE RECHARGEABLE BATTERY ASSEMBLIES FOR ALL TYPES OF ELECTRONICS.
RADIOS, SCANNERS, CORDLESS TOOLS, BAR CODE READERS, GPS, SCIENTIFIC, SURVEILLANCE

GENERAL ELECTRIC
MPD PLS MPA 4850P $ 34.50
MPD PLS MPA 4860P $ 39.50
MPR MPS MPX 763/777 $ 39.50
MONOGRAM 4506P1/3 $ 37.50
MAXON SA-1155 1160 $ 39.95

MOTOROLA
MX300 HT600 MT1000 STX
NTN 4585 4824 6414 $ 37.50
NTN 6447 5521 6546 $ 37.50
NLN 6860 NTN 4327 $ 39.50

MIDLAND
70-B10 B16 B19 B21 $ 39.95
B25 B26 B32 B36 B60 $ 39.95

UNIDEN
APX650 1050 1105 $ 32.50
1010 1070 1100 $ 32.50
1120 1200 Series $ 32.50
BP2500 650mAh $ 19.50
BP205 1600mAh $ 22.50

ICOM
BP2 / BP3 /BP22 $ 19.50
BP5 / BP23 / 24 $ 27.50
BP7 / CM7/ BP8 $ 34.60
BP157/174/180 $ 34.60
CM140/141/166 $ 41.50

YAESU
FNB 3 4 12 14 16 $ 32.95
FNB19 21 26 27 38 $ 32.95
FNB 10 1117 25 35 $ 23.95

RADIO SHACK
HTX 202/404 $ 22.50
NEW NiMh HTX pack
8.4V 1650mAh $ 39.60

KENWOOD
PB2/6/33/34 $ 28.50
PB7/8/9/13/14/18 $ 34.50
KNB6/7/12/14/15 $ 34.60
PB10/26/26/32 $ 24.60

CORDLESS DRILLS
50% MORE CAPACITY.
Any brand 7.2V $ 21.60
Any brand 9.6V $ 29.50
Any brand 12.0V $ 36.50
Any brand 14.4V $ 39.60
Any brand 18.0V $ 44.60

See our web pages about rebuilding battery packs used for Land Surveying.

BATTERY REBUILD SERVICE

FOR INFORMATION ABOUT YOUR REQUIREMENTS ... CONTACT US:
USE THE EASY INFO. REQUEST PAGE AT http://www.primecell.com
PHONE OR FAX : (814) 623-7000 E-MAIL TO: sales@primecell.com
SEND PACKS FOR FREE QUOTATION BY: UPS, FEDEX, OR US MAIL

CUNARD ASSOCIATES INC., 9343 US RT 220, Bedford, PA 15522

Circle #79 on the Reader Service Card.

velleman Inc.

www.vellemanusa.com
D.I.Y. KITS
Oscilloscopes
Measuring Instruments
call or email for our new catalog and name of local distributor
Security Products

7415 WHITEHALL STREET SUITE 117, FORT WORTH, TX 76118
TEL: (817) 284-7785
FAX : (817) 284-7712
www.vellemanusa.com email : Velleman.Inc@velleman.be

Circle #80 on the Reader Service Card.

REFILL INKS FOR INKJET PRINTERS

Refill your old cartridge and save. All refill kits come with instructions and needed materials for refilling inkjet cartridges. Available for Canon, Epson, Hewlett Packard, Apple, Compaq, and Lexmark printers.

HARD-TO-GET PRINTER RIBBONS

Gorilla Banana, Commodore, Texas Instruments, Centronics, Riteman, Apple, Printronix, Star

Over 300 different ribbons in stock.
All ribbons new, not re-inked.

Check our web page or write for complete price list.

H.T. ORR Computer Supplies
249 Juanita Way, Placentia, CA 92870-2216
714-528-9822 · FAX 714-993-6216
Toll Free 1-800-377-2023
e-mail: Htorr@aol.com
http://home.adelphia.net/~htorr

Circle #78 on the Reader Service Card.

The Pocket Programmer

The portable programmer that uses the printer port instead of a internal card. Now with easy to use Windows software that programs E(E)prom, Flash & Dallas Ram. 25/27/28 & 29 series from 16K to 8 Megabit with a 32 pin socket. Adapters available for MCU's 874X, 875X, Pic, Atmel, 40-Pin X16, Serial Eprom's, PLCC, Bi-Prom's, Eprom Emulator to 32K X

Only $149.95

Same Name, Address & Phone # for 19 Years.... Isn't it Amazing ?

Intronics, Inc.
Box 12723 / 612 Newton St.
Tel. (913) 422-2094 Add $7.00 COD
Fax (913) 441-1623 Add $6.00 Shipping

WWW.IN-KS.COM Visa/MC/Amex/Disc

Electronics Showcase

Special Advertising Section!

Special products and services for the electronics enthusiast.

Top Secret Consumertronics
In business 25+ years - established professionals
Free Online Catalog!
www.tsc-global.com
Exciting Hi-Tech Survival Books, Manuals, Tapes

Stopping Power Meters	Cellphone/Pager Manuals
KW-HR Meters/VHS	Fax Machine Security
Polygraph Secrets	Beyond Phone Color Boxes
B. vanEck Tempest/VHS	Caller ID & ANI Security
ATM/Credit Card Security	Radionics/ Heal Thyself
Hacker Files/Dirty2Doz	EM Brainblaster
Computer/Internet Security	Mind Control/Under Attack
Identity Theft Manual	Social Engineering
High Voltage Devices	Remote Office Strategies
Stealth Technology	Casino Secrets - *100 more!*

Catalog has descriptions, prices, policies
Consumertronics
P.O. Box 23097, ABQ, NM 87192
(505) 321-1034 Printed Catalog: *$3*

UHF RADIO MODEM RM-232-914 FCC APPROVED
High Performance Low Power Wireless Data Link
Capable of Through Put Rates of 9600bps

- Fully acknowledged data transfer
- Addressable point-to-point mode
- Extended range in repeater mode
- Built-in software configurator
- Remote over-air configuration
- Broadcast multi-drop mode
- DTE speed 600-115200bps
- Indoor range to 30m
- Outdoor range to 150m
- Low current consumption

IDEAL FOR ADDING WIRELESS CONNECTIVITY TO ANY **RS232** LINK!
www.lemosint.com
LEMOS INTERNATIONAL
Microwave and RF Specialists
1305 Post Road
Fairfield, CT 06430
Tel: (508) 798-5004
Fax: (508) 798-4782
Email: Sales@lemosint.com

SERIAL GRAPHIC LCD

PICL-2464 $99.00
Sharp LM24014 240 x 64 LCD
E.L. Backlight
5" x 1 5/16" Viewable Area
PIC 16F877 Re-Programmable
Switches, A/D & I/O Bits

LCD MONITOR KIT

A Complete 12.1 TFT LCD Kit With Controller and 180 Nit 16.7M Color XGA Panel- Just Plug Into VGA port and add 12 volts D.C.!
SK-2005R $299

12.1" LCD MONITOR

Rugged Metal Case
On Screen Display
Free Z-Mount
Resistive & Capacitive Touch Screen Options Available. 1024 x 768 16.7 Million Colors VGA and SVGA
MTR-EVUE-12 $399.00

EARTHLCD.com
"The World Wide LCD Source"
32701 Calle Perfecto - San Juan Capistrano, CA 92675
Ph: (949) 248-2333 Fax: (949) 248-2392
See the World's Largest Collection of LCD's and LCD Products at http://www.EarthLCD.com

The new iSun™ – a complete **solar charger for small electronics.** Plugging accessories included that will enable you to run over 90% of all small electronics. 6 or 12 volt selectable!

Toll Free Order Line:
1-888-GO 4 KITS
Secure On-Line Ordering
www.qkits.com
Call 613-544-6333
for free catalog
49 McMichael St., Kingston, ON
K7M 1M8, CANADA

Download a Complete Virtual Workbench Today
Shareware version www.labcenter-electronics.com
PIC Micro Special $99 includes; Graphical LCD, Logic Analyzer, Scope, Signal generator Probes, & more

PROTEUS NEW VSM Virtual System Modelling
www.labcenter-electronics.com
Build It In Cyberspace
Develop and test complete micro-controller design without building a physical prototype. PROTEUS VSM simulates the CPU and any additional electronics used in the design. And it does it in real time.
Email, phone or fax for a free demo CD Today

- CPU models for 8051 and PIC series, 68HC11 & ATMEL AVR micro-controllers available now. More CPU models under development.
- Interactive device models include LCD displays, RS232 terminal, universal keypad plus a range of switches, buttons, pots, LEDs, 7 segment displays and more.
- Extensive debugging facilities including register and memory contents, breakpoints and single step modes.
- Source level debugging supported for selected development tools.
- Over 4000 standard SPICE models included.
- Integrates with PROTEUS PCB Design to form a complete electronics design system.

R4 Systems Inc.
Tel:905.898.0665
Fax: 905.898.0683
info@r4systems.com

www.labcenter-electronics.com

PCBexpress www.pcbexpress.com
- *No tooling charge!*
- *Lot charges start at $80*
- *Simple order process*
- *Quickturn, low quantities*

For a DISCOUNT on your next order enter this Code: NV5412

TWO SERVICES FOR **CIRCUIT BOARDS**
www.pcbpro.com
- *Quick price comparisons*
- *More options & added features*
- *Prototype & production quantities*

INSTANT ON-LINE QUOTES! (NO SIGN-UP REQUIRED)

SINGLE SIDED PCBS SAVE MONEY
PROTOTYPES TO VERY HIGH VOLUMES NO MINIMUM SIZE ORDER, VERY COMPETITIVE
DOUBLE SIDED PCBS
$1,000.00 MINIMUM ORDER, LOWEST PER UNIT PRICE IN THE INDUSTRY, FOR MEDIUM TO HIGH VOLUME ORDERS
UL & CSA, AN ISO-9002 COMPANY
OTHER SERVICES: MULTILAYER, FLEXIBLE PCBS, DESIGN OF PCBS, FROM YOUR HAND DRAWN SCHEMATICS AND ASSEMBLY (SMT&PTH)
V&V MACHY & EQUIP. INC.
V&V MACHY AND EQUIP. INC. (HOUSTON TX. OFFICE)
PH. (281) 397 6101 FAX (281) 397 6220
MARKETING TECH. S.A. (MEXICO PLANT)
PH. 011 525 3013301, FAX 011 525 3019805
LOWEST PRICE IN THE INDUSTRY FOR SINGLE SIDED PROTOTYPES
DELIVERY IN 5 DAYS.
EMAIL: sales@vandvmachy.com SITE: www.vandvmachy.com

CUSTOM PLASTIC PARTS

MODELS (WOOD AND RESIN). TO EVALUATE YOUR PARTS BEFORE YOU COMMIT TO MANUFACTURE A MOLD. MOLD DESIGN AND BUILDING.

PRODUCTION OF INJECTION MOLDED PARTS. NO ORDER TO SMALL OR TO BIG. VERY COMPETITIVE ON HIGH LABOR PARTS.

We can also inject your parts on manual low pressure machines for very small runs or prototypes of parts up to 2 oz. At a surprisingly low price.

USA. Office: V & V Mach. And Equip. Inc.
Tel. (281) 397-8101, Fax. (281) 397-6220

Please send blue prints or samples to:
Marketing Tech. S.A. Alamo 93, 4o. Piso, Santa Monica
Tlal. Edo. De México. C.P. 54040.
TEL. 011 (525) 3613351, Fax. 011 (525) 3615996
ATTN. VICTOR M. MENDOZA.
Mobil. 011 (525) 4398913

PLEASE VISIT OUR SITE
www.vandvmachy.com

PRINTED CIRCUIT BOARDS

QUALITY PRODUCT
FAST DELIVERY
COMPETITIVE PRICING

* UL approved
* Single & Double sided
* Multilayers to 8 layer
* SMOBC, LPI mask
* Reverse Engineering
* Through hole or SMT
* Nickel & Gold Plating
* Routing or scoring
* Electrical Testing
* Artwork or CAD data
* *Fast* quotes

10 pcs (3 days)
1 or 2 layers **$249**
10 pcs (5 days)
4 layers **$695**
(up to 30 sq. in. ea.) includes tooling, artwork, LPI mask & legend

PROTOTYPE THROUGH PRODUCTION
PULSAR, INC

9901 W. Pacific Ave.
Franklin Park, IL 60131
Phone 847.233.0012
Fax 847.233.0013
Modem 847.233.0014

We will beat any competitor's prices!!!
yogii@flash.net · flash.net/~yogii

Synthesizer Modules, Guitar Effects, Mixers, EQs, Tube PreAmps, and dozens of other kits for

PAiA ELECTRONIC MUSICIANS

Theremin 9505K Kit $89.75
The PAiA Theremax uses the same heterodyne principles as the original turn of the century instrument for classic tone and adds features made possible by modern ICs.
Shown with optional lectern case.

FatMan Analog MIDI Synth 9308K Kit $154.00
A complete music synthesizer with all the big bottom and phat sound that makes analog famous. 20 knobs and controls for real-time sound sculpting. Compatible with standard MIDI sources like keyboards or computers.
Desktop case or rack panel available.

Check out **http://Paia.com** for schematics, tech details, firmware source files and more...

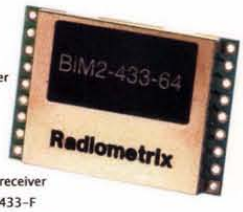
PAiA Electronics • 3200 Teakwood Lane • Edmond, OK 73013
405.340.6300 • fax:405.340.6378 • email:info@paia.com

BiM2 433 MHz

900 MHz Available January 2002

High Speed Wireless Data Transceiver
Physical Dimensions: 33 mm x 23 mm x 4 mm

- Data rates up to 160 kbps
- RX sensitivity -100dBm
- Usable range up to 200m
- SAW controlled FM transmitter
- 3V and 5V versions
- Low power requirements
- TX power 10mW @ 5V
- Fully screened
- Double conversion Superhet receiver
- Plug in replacement for BiM-433-F



www.lemosint.com

LEMOS INTERNATIONAL
Microwave and RF Specialists
48 Sword Street
Auburn, MA 01501
Tel: (508) 798-5004
Fax: (508) 798-4782
Email: Sales@lemosint.com

MATCO

EverSecure™
www.matco.com

- On-Line Ordering
- OEM Security Products
- Monitors, Cables, Accessories
- Law Enforcement Equipment
- Discreet Wireless Systems {$89-$269}

Fax: 847-303-0660
Canada: 877-720-9222
Sales: 847-303-9700
Toll Free: 800-719-9605

HVW TECHNOLOGIES

HIGH-TECH SOLUTIONS TO HIGH-TECH PROBLEMS

BASIC Stamp™ Prototyping Made Easy...

$32.95 (Kit)

Stamp Stacks™ mount directly on any breadboard to make prototyping easy. Complete -just assemble, connect power and a serial cable. 100% BASIC Stamp™ compatible. Robust, Repairable, Inexpensive. Starter kits available.

Pic Compilers/Programmers/Protoboards·Serial LCDs IR Ranging Sensors...

HVW Technologies Inc.
Tel: (403)730-8603
Fax: (403)730-8903
VISA/MC Accepted
www.HVWTech.com

CONTROL · MEASURE · INPUT

MODEL 40–$109
- RS-232 interface
- 28 lines digital I/O
- Eight analog inputs
- PWM output
- Three stepper ports

MODEL 100–$279
- 12-bit 100KHz A/D
- Four analog outputs
- Three timer counters
- 24 digital I/O

PRAIRIE DIGITAL, INC.

920 SEVENTEENTH ST., INDUSTRIAL PARK
PRAIRIE DU SAC, WI 53578
TEL: (608) 643-8599 · FAX: (608) 643-6754

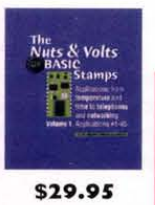
Scope + ScopeAlyzer™ = Logic Analyzer

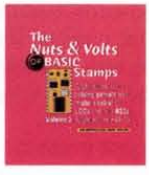
- Attach to 20 MHz scope
- 100 MHz sample rate
- 16 channels
- 128K sample memory
- Trigger (0,1,X,edges)
- Pan and zoom
- One key data snapshot
- Scope trigger output

The ScopeAlyzer™ is a precision crafted, professional grade instrument that attaches to an ordinary 20 MHz oscilloscope and extends its capability to a high performance logic analyzer.

Model 61050 $395 Model 61100 $595

Barrett Instruments
www. BarrettInstruments.com 800 272-1936





$29.95 each

Order Both Volumes For $49.95! Plus S/H

The Nuts & Volts of BASIC Stamps Volumes 1 & 2

"... is as much of a BASIC Stamp reference book as it is an application idea guide ..."

Call our orderline at 1 800 783-4624
Or order online from the Nuts & Volts Bookstore
www.nutsvolts.com

ActiveWire® USB
Simple USB Interface!

- Works with MacOS 8/9, Win98/2K/ME FreeBSD and Linux!
- 24Mhz CPU core with USB
- Firmware downloadable via USB
- 16 bit parallel Input/Output
- See web-site for add-on boards
- All drivers, manuals, demos are on our web-site for immediate download!

$59 plus shipping

ActiveWire, Inc.
www.activewireinc.com
ph +1.650.493.8700 x203 fax +1.650.493.2200

Learning RVK-Basic Part 4

By Bob Vun Kannon

RVK-Basic is a free Basic compiler for the Atmel AVR line of microcontrollers. You can download a copy of this compiler from the Nuts & Volts web site. With this compiler, you can write and compile very fast, efficient programs for most of the AVR microcontrollers.

In this article, we will explore the use of the A/D converter and the UART. I will be assuming that the reader has already worked his way through the first three articles. If you missed them, contact *Nuts & Volts* for back issues.

Analog-to-Digital Conversion

The analog-to-digital (A/D) converter contained in some of the AVR devices is a very useful gadget. It will convert an analog voltage into a digital number for you on command.

The A/D converter is a 10-bit converter. Its result is a 10-bit number, so it won't fit in a byte variable. So, now we need to use an integer (two-byte) variable. In RVK-Basic, this is done by using a variable name which ends in a percent sign, like var%.

Integer variables in RVK-Basic are unsigned. They have a possible range of values from 0 through 65535 (&H0 through &HFFFF). They can be used in IF statements and equations just like byte variables, as we did in previous articles. The main difference between integers and byte variables is that the integers are stored in static RAM in the chip. This means that it takes two clock cycles to bring the variable into the processor from RAM and two more clock cycles to write the result back out to RAM. Thus, integer computations proceed more slowly than byte operations.

In order to perform an A/D conversion and put the result into an integer variable we use the A2D statement. The basic syntax is A2D variable, mux, option. The AVR chips generally have more than one channel that can be read by the A/D converter. So you could potentially have as many analog inputs to the chip as it has channels. The "mux" in the A2D syntax is a number, which corresponds to the particular channel to be converted. These channels are numbered from 0 up to as many as 7 for the 8535 processor.

There is an extensive list of options in RVK-Basic for the A2D command. Please read the RB.TXT file supplied with the compiler for documentation on all the options. In this example, we will be using the IDLE option. This is a neat feature which allows for very accurate, noise-free conversions. When IDLE is specified, the processor shuts down while the conversion is being performed and then wakes back up when the conversion is finished. That way, there is no digital noise from the processor interfering with the conversion.

So let's write a program to perform A/D conversions for us and display the result.

To display the result, we will put the answer out on the B port to the LEDs on the development board. The only problem this causes is that there are only eight LEDs and there are 10 bits in the integer. An easy way to solve this is to throw away the two least significant bits. We can do this with the SHIFT statement.

The idea of shifting is best seen looking at a number in binary. If we have a number like 18, in binary that is

00010010

Now shifting it right one bit will give

00001001

Shift it right one more time and you will get

00000100

See how that works?

So if we shift our 10-bit number to the right two times, we will have an eight-bit number in the lower byte of the integer. For example, 0000001100110011 would become 0000000011001100. This can be performed by writing:

```
SHIFT var%,2,RIGHT
```

The final piece of the process is to get the bottom byte of the integer into a byte variable (so we can write that byte out to Port B). This is done in RVK-Basic by setting a byte equal to an integer. So the entire program will now become the following.

```
DEVICE 2333
MHZ    4

DIRPORT B,OUT

DO
       A2D x%,0,IDLE
       SHIFT x%,2,RIGHT
       temp = x%
       OUTPORT B,temp
LOOP
```

To run this program, hook a potentiometer (10K will work nicely) up to the power and ground pins of the analog header of the development board and hook the wiper of the pot to Channel 0 of that port. When you run the program, you will see the digital number shown on the LEDs change as you turn the pot. When dealing with data from the real world, it is often very useful to be able to filter the data to remove noise. For this purpose, there is a FILTER statement in RVK-Basic.

I'm going to modify the program we just wrote to filter the data coming in from the pot. In this next program the input will only be read every tenth of a second. I will filter the data by a factor of 2^4 (two to the fourth power) which will give us a 1.6 second filter. Run the following program and make a quick change to the pot. You will see the result change rather slowly and gradually creep into its final value. This is the software equivalent of using a resistor and capacitor to make a low-pass filter. You will want to try changing the "4" in the FILTER statement to a "3" and watch-

ing the results speed up by a factor of 2.

```
DEVICE 2333
MHZ    4

DIRPORT B,OUT

DO
        A2D y%,0,IDLE
        FILTER x%,y%,4
        SHIFT x%,2,RIGHT
        temp = x%
        OUTPORT B,temp
        PAUSE 100
LOOP
```

If you intend to run this program on an STK500 board, I recommend changing the "B" in the DIRPORT and OUTPORT statements to "D" and connecting the jumper from the LEDs to port D. I am told that the upper bit on the LEDs may not function properly if driven from port B on the STK500 board.

The Universal Asynchronous Receiver-Transmitter

One of the more useful things you can do with an AVR microcontroller is to connect it to a PC. Information can flow in both directions. The first thing we will do is to transmit the data from our pot (hope you haven't disconnected it yet) to your PC. I'm assuming you have a real PC that has an RS-232 port on it and not one of these newfangled USB ports.

The AVR development boards have a nine-pin connector for RS-232 communications. So all you will need to do is connect a serial cable from the nine-pin connector of the development board to the nine-pin connector on the back of your computer. Follow me as I write a little more code.

There are two statements in RVK-Basic for running the UART. XMIT controls transmissions out of the UART and RECV controls reception from the UART. First, we will just transmit the data from the POT out of the UART in the following program. The first XMIT statement initializes the UART to the baudrate we want. The second XMIT statement actually transmits the data. Please refer to the detailed description of the XMIT and RECV statements in the file RB.TXT.

```
DEVICE 2333
    MHZ    4

    DIRPORT B,OUT
    XMIT INIT 9600

    DO
            A2D y%,0,IDLE
            FILTER x%,y%,4
            SHIFT x%,2,RIGHT
            temp = x%
            OUTPORT B,temp
            XMIT OUT temp
            PAUSE 100
    LOOP
```

Now, if you were to look at the TXD output pin of the chip with a scope, you would see a stream of ones and zeros going out in bursts every tenth of a second. It would be much more instructive to actually see this data showing up on the screen of your PC.

The following program can be run on your PC under QBASIC, or compiled by Quickbasic or Power Basic and then run. So long as it is running, anything coming in over the serial port (COM1) will show up as a number on the screen. The program ends whenever you hit a key. This should run on any IBM compatible PC with a COM port. If it uses Windows, you may need to go to the command prompt to run the program.

```
OPEN "COM1: 9600,N,8,1,RS,CD0,CS0,DS0" FOR RANDOM AS #1

    DO
      IF eof(1)=0 THEN
        a$ = INPUT$(1,1)
        PRINT ASC( a$);
      END IF
      IF INKEY$<>"" THEN EXIT DO
    LOOP
    PRINT
    PRINT
    END
```

To get this up and running, type EDIT from the command prompt and enter the program as you see it here. Save it under some convenient file name like TEST.BAS. Then you should be able to run it by the command "QBASIC TEST." I hope that you get this all up and running with no trouble and that it opens up new avenues for you in how to use an embedded microcontroller. Now, let's get our data flowing in both directions. The following program in RVK-Basic will read a byte from the PC and then add one to it and send it back to the PC. So data will flow only when the PC sends something.

```
    DEVICE 2313
    MHZ    4
    XMIT INIT 9600
    RECV INIT 9600
    RECV INTERRUPT ON
    rflag = 0

    DO
            IF rflag | 0 THEN
                    INCR rbyte
                    XMIT OUT rbyte
                    rflag = 0
            END IF
    LOOP

'==============================
'   INTERRUPT HANDLER FOR      =
'   RECV FROM THE UART         =
'==============================
 INTERRUPT RECV
    PUSHFLAGS
    PUSHREG
    rflag = 1
    RECV IN rbyte, errflag~
    POPREG
    POPFLAGS
 END INTERRUPT
```

There are several new ideas in this program that deserve comment. The RECV INTERRUPT ON statement enables interrupts from the receiver side of the UART. Whenever a byte comes into the UART, an interrupt is generated. This means that no matter what the program is doing, it will jump to the interrupt handler for that interrupt. In the case of the RECV, it will jump to the statement INTERRUPT RECV.

The two PUSH statements save the current state of the processor data and flags onto the system stack. At the end of the interrupt routine, the two POP statements retrieve the processor data and flags from the stack so that it can return to the main program in the same state as when the interrupt occurred. These statements should be placed in every interrupt handler that you write. The real work of the interrupt handler is in the two statements in the middle. It sets the variable rflag, which informs the main program that a byte has been received. The RECV IN statement loads the data from the UART into the variable rbyte and also loads a byte of error flags (which we ignore) into "errflag~." This is a new type of variable to the

student at this point. By placing a tilde on the end of the name, I have specified that the variable is a byte variable stored in RAM (not in a register). Remember that you only get to use 28 register variables in a program and all others must go into RAM. So this shows you how to do that.

Back in the main program, we simply watch for the rflag to become set. Whenever this happens, we increment the rbyte (that's what INCR does) and transmit it out to the PC. So, if the PC sends us an "A," we will echo back a "B." You can try this out with the following program on your PC.

```
    OPEN "COM1:
9600,N,8,1,RS,CD0,CS0,DS0"
FOR RANDOM AS #1

    PRINT "HIT ESC TO END
THIS PROGRAM."
          PRINT
          DO
         A$ = INKEY$
         IF A$<>"" THEN
           IF ASC(A$) = 27
THEN EXIT DO
           PRINT #1,A$;
         END IF

             IF EOF(1) = 0 THEN
               a$ = INPUT$(1,1)
               PRINT ASC( a$);
             END IF
          LOOP
          PRINT
          PRINT
          END
```

When you have this PC program running together with the AVR program, you will have established two-way communications between your PC and the development board.

In the next article, we will take up program structure. **NV**

The Standard for checking Capacitors in-circuit

Good enough to be the choice of Panasonic, Pioneer, NBC, ABC, Ford, JVC, NASA and thousands of independent service technicians.

Inexpensive enough to pay for itself in just one day's repairs. At $179, it's affordable.

And with a 60 day trial period, satisfaction guaranteed or money-back policy, the only thing you can lose is all the time you're currently spending on trying to repair all those dogs you've given up on.

CapAnalyzer 88A

Locate shorted or leaky components or conditions to the exact spot *in-circuit*

Still cutting up the pcb, and unsoldering every part trying to guess at where the short is?

$179

Your DVM shows the same shorted reading all along the pcb trace. LeakSeeker 82B has the resolution to find the defective component. Touch pads along the trace, and LeakSeeker beeps highest in pitch at the defect's pad. Now you can locate a shorted part only a quarter of an inch away from a good part. Short can be from 0 to 150 ohms

LeakSeeker 82B

***Available at your distributor, or call* 561-487-6103**

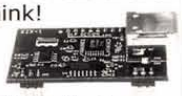
Electronic Design Specialists www.eds-inc.com

Circle #89 on the Reader Service Card.

USB

Add a USB interface to your next project...it's easier than you might think!

DLP-USB1
$34.95



- Connect to the PC without shutting down
- Up to 8-megabit per second data rate
- Simple FIFO interface
- Download free USB drivers
- Operational power taken from the USB port

- As easy to use as the RS-232 ports
- Evaluation boards available-see site for details

PIC 16F877 Microcontroller, Flash Programmer, and High-Speed USB Interface... all in one tidy little package!

DLP-IO26
$89.95

- USB Interface
- 8K ROM
- 368 RAM
- 256 EEPROM
- 26 I/O including 8-ch., 10-bit A/D

- Use with any PIC assembler/compiler that creates standard 8-bit HEX files
- No device programmer required! On-board USB port is used for both firmware download and communication with host PC at up to 2 megabits per second

DLP Design

Download datasheets and order online at:
www.dlpdesign.com/usb/
P.O. Box 503762, San Diego, CA 92150
858-513-2777

"We help engineers and hobbyists worldwide embrace USB technology"

Test Equipment Connection Corporation

Test Equipment Connection is looking to purchase your excess or underutilized electronic test and measurement equipment. We buy the largest variety of electronic test equipment in the industry.

WE BUY TEST EQUIPMENT

RENT REPAIR TRADE SELL

CALL: 800.615.8378 FAX: 800.819.8378
WWW.TestEquipmentConnection.COM
Specialist in Hewlett-Packard, Tektronix, and many more manufacturers.

Circle #90 on the Reader Service Card.

EZ-EP DEVICE PROGRAMMER - $169.95

Check Web!! -- *www.m2l.com*

Fast - Programs 27C010 in 23 seconds

Portable - Connects to PC Parallel Port

Versatile - Programs 2716-080 plus EE and flash (28, 29) to 32 pins

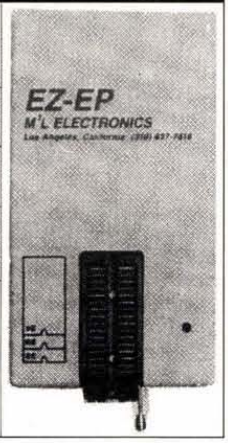
Inexpensive - Best for less than $200

- Correct implementation of manufacturer specified algorithms for fast, reliable programming.
- Easy to use menu based software has binary editor, read, verify, copy, etc. Free updates via bbs or web.
- Full over current detection on all device power supplies protects against bad chips and reverse insertion.
- Broad support for additional devices using adapters listed below.

Available Adapters

EP-PIC (16C5x,61,62x,71,84)	$49.95
EP-PIC64 (16C62-5,72-4)	$39.95
EP-PIC12 (12C50x)	$39.95
EP-PIC17 (17C4x)	$49.95
EP-51 (8751,C51)	$39.95
EP-11E (68HC11 E/A)	$59.95
EP-11D (68HC711D3)	$39.95
EP-16 (16bit EPROMS)	$49.95
EP-Z8 (Z86E02,3,4,6,7,8)	$39.95
EP-SEE2 (93x,24x,25x,85x)	$39.95
EP-750 (87C750,1,2)	$59.95
EP-PEEL (ICT22v10,18v8)	$59.95
EP-1051 (89C1051,2051)	$39.95
EP-PLCC (PLCC EPROMs)	$49.95
EP-SOIC (SOIC EPROMs)	$49.95
EP-TSOP (TSOP EPROMs)	$59.95

Many Other Adapters Available



M²L Electronics
970/259-0555
Fax:970/259-0777
250 CR 218
Durango, CO 81301
CO orders please add 7% sales tax
http:/www.m2l.com

Circle #73 on the Reader Service Card.

68HC11 & 68HC12 Microcontroller Modules!

Unique design-- just plug them right into your solderless breadboard!

MicroStamp11™
- tiny 1-inch x 1.4-inch 68HC11 module from $49

MicroCore-11™
- compact 2-inch x 2-inch 68HC11 module from $68

Adapt-11™ Family
- 68HC11 modules with lots of I/O lines from $63

Application Cards Available:
- *stepper motor driver*
- *voice record/playback*
- *LCD/keypad/PC keyboard*
- *data acquisition • DAC*
- *CAN • ethernet • more!*

Adapt812™ Family
- based on 68HC812A4
- from $79

Adapt912™ Family
- choice of B32, D60, DG128
- from $99

MicroBDM912™
- lowest-cost BDM pod!
- only $79!

Toll-free: 1-877-963-8996

Technological Arts

Visa•MasterCard Discover•Amex

Phone: (416) 963-8996 Fax: (416) 963-9179

www.technologicalarts.com

Win with Nuts & Volts

PAID SUBSCRIBERS ARE *AUTOMATICALLY* ENTERED EACH MONTH!

This month's winners ...

Mike Bernstein of Tucson, AZ
Albert Bochter of Baden, PA
Gene Nixon of Orange, CA

This month's sponsor ...

RAMSEY
RAMSEY ELECTRONICS
800-446-2295
www.ramseykits.com
See their ad on Page 49!!

$130.00 Value!!

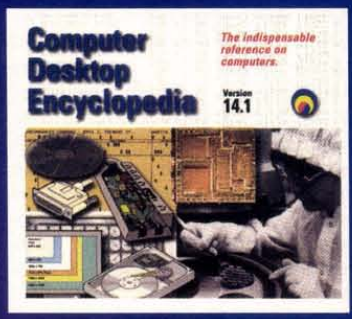
New for 2002!

The new and improved synthesized FM Stereo Transmitter! Rock solid stability from 88-108 MHz, cleaner audio, better separation, will keep even the pickiest audiophile happy! Kit comes complete with case, knobs, antenna, and power supply. Just build it, and you're on the air!

To Subscribe – Just fill in and mail the card supplied in the magazine or call our toll free order line at **(800) 783-4624** with a Visa or MasterCard. If you do not wish to order a subscription, but would like to be entered in our drawing, simply send or email your name, address, and telephone number to *Nuts & Volts*, 430 Princeland Ct., Corona, CA 92879 or drawing@nutsvolts.com. No phone entries accepted. All orders/entries must be received by the last day of the month to be included in that particular month's drawing.

Computer Desktop Encyclopedia

Experience it today at the Nuts & Volts website.



For Experts and Novices – The Encyclopedia contains more than 15,000 definitions, illustrations, photos, charts and diagrams, and covers the field from micro to mainframe.

Everyone Needs This – You can't escape computer and telecom lingo in this day and age. The Encyclopedia covers only the high-tech world, but makes it interesting for everyone.

Twenty Years in the Making – Starting as The Computer Glossary in 1980, the Encyclopedia is the longest-running computer dictionary. Edited by Alan Freedman, noted computer lexicographer with 40 years of experience in the industry, the Encyclopedia is the most comprehensive reference of its kind.

If computer terminology or high tech mumbo jumbo seems to leave you on the outside looking in, you need to check out this cool feature available now at **www.nutsvolts.com**

Check it out. It's informative, it's here now ...

The Blinkery Blinkeroo Flashing Light

By George Philips, Rachel Philips, and Thomas Philips

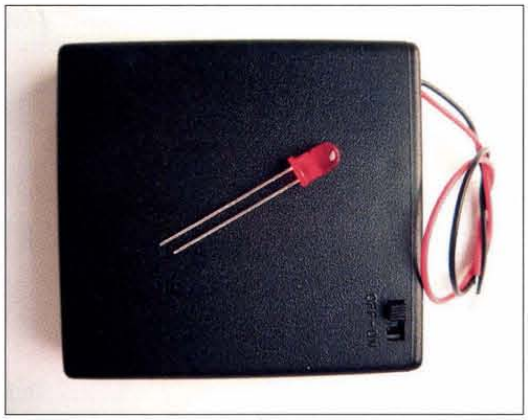
This is a perfect beginner's gadget for someone who has never built an electronic project before. It's intended to be built by kids with adult supervision, since it requires soldering.

The Blinkery Blinkeroo is a small battery powered flashing light that can be built in half an hour by someone who has never built an electronic project. It costs less than $3.00 and has only two components: a battery case with a built-in switch and a flashing light-emitting-diode (LED). Furthermore, it requires only two soldered joints to attach the LED to the battery. Its simplicity and ease of assembly makes it a perfect introduction to electronics for the budding hobbyist or young Scout. Two of the authors (George and Rachel, age 15 and 9) built Blinkery Blinkeroos for themselves and their friends with ease.

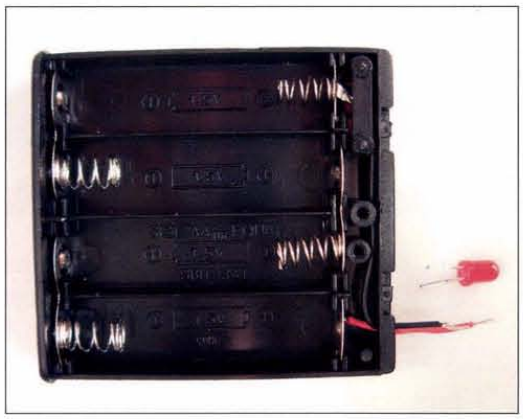
The battery case and flashing LED are best bought from Digi-Key Corporation (1-800-344-4539 or www.digikey.com). Obtain a four AA cell battery case (item number SBH-341AS-ND) and a flashing LED in the color of your choice (Bright Red: 67-1499-ND, Dark Red: 67-1497-ND, Red: 67-1498-ND, Green: 67-1496-ND or Yellow: 67-1495-ND). A similar battery case and green LED can be obtained at RadioShack (items 270-409 and 276-305 respectively), but the Digi-Key battery case is easier to use.

Remove the cover of the battery case by sliding it forward and you will see two wires — one red and the other blue — connected to the positive and negative terminals of the batteries respectively via a switch. The wires exit the battery case through a hole near the positive battery terminal. Cut the leads half an inch away from the case and use a wire stripper to remove one third of an inch of insulation from each wire. Pull both leads back through the hole with a pair of tweezers.

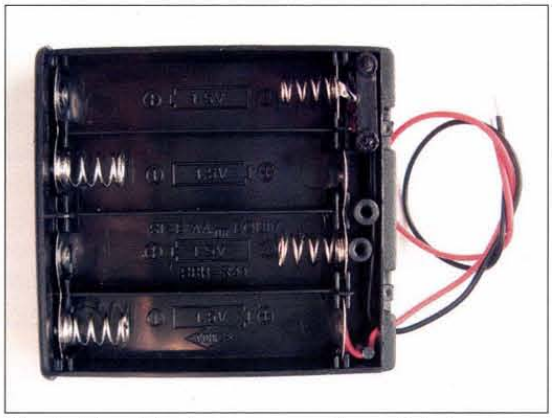
Next, using needle-nosed pliers, bend the leads on the LED so that they are parallel to its rear surface. Start the bend 1/8" away from the rear surface to allow for the thickness of the battery case. The longer lead is the anode, and must be connected to the red (or positive) wire. The shorter lead is the cathode, and must be connected to the black (or negative) wire.



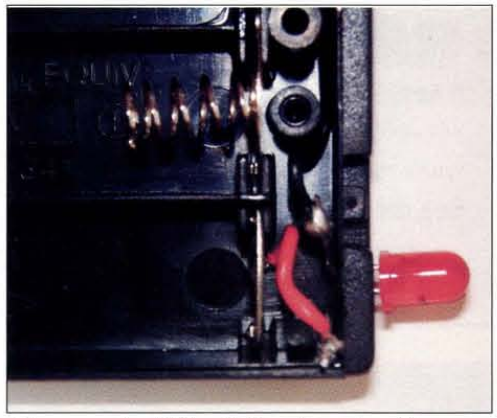
The entire component list — one LED and one battery case with switch.



Ready for assembly. The battery case and LED with their leads trimmed.

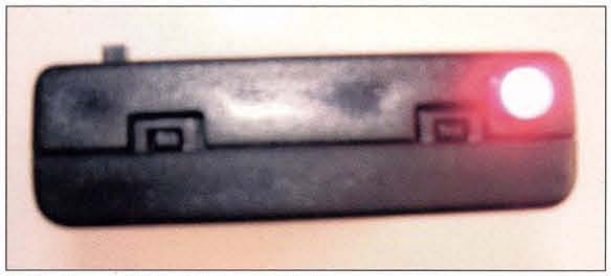


The inside of the battery case. The switch is at top right.



Close-up detail. The LED soldered and in place.

Almost ready for action! The Blinkery Blinkeroo with its batteries installed.



Side view of the Blinkery Blinkeroo.

Trim both leads to a length of half an inch, but ensure that the anode remains longer than the cathode to facilitate correct identification. An incorrectly wired LED will not flash, and may even be damaged or destroyed. Slip both leads of the LED through the hole in the battery case and, under adult supervision — solder the red wire to the anode and the black wire to the cathode as follows:

1. Connect the LED to the wires. Twist the red wire and the anode lead together and the black wire and the cathode lead together. Ensure that the two junctions do not touch each other.

2. Apply a hot soldering iron to the first junction for about 10 seconds. Ensure that the soldering iron does not touch the plastic battery case. Inexpensive soldering irons can be purchased from Digi-Key (Item WP25-ND) or RadioShack (Item 64-2184).

3. Press solder wire against the hot junction (not against the soldering iron) to melt it. Use just enough solder to cover the junction.

4. Remove the solder and the soldering iron and do not move the leads as they cool.

5. Repeat these steps for the second junction.

Resist the temptation to solder the LED to the wires before passing its leads through the hole in the case. The soldered joints are too large to fit comfortably through the hole.

Two vitally important words of caution are in order.

1. IT IS IMPERATIVE THAT THE WIRES BE SOLDERED CAREFULLY UNDER ADULT SUPERVISION – A SOLDERING IRON CAN REACH A TEMPERATURE OF 700° F OR MORE, AND CAN CAUSE SERIOUS AND LIFE-THREATENING BURNS IF IMPROPERLY USED.

2. WEAR SUITABLE PROTECTIVE CLOTHING, INCLUDING GLOVES TO PROTECT YOUR HANDS AND GOGGLES TO PROTECT YOUR EYES, WHILE SOLDERING.

After the soldered connections have cooled, bend them away from each other so that they cannot touch and short the battery, and stick the rear surface of the LED to the battery case using a small dab of fast setting adhesive such as SuperGlue. Finally, put in four AA cells and slide the case shut. Your Blinkery Blinkeroo is ready to go! To operate it, slide the power switch to the On position, and allow the Blinkery Blinkeroo to welcome you to the wonderful world of electronics with its rhythmic blinking!! **NV**

Blinkery Builders
Rachel and George

RAMSEY

GET THE NEW CATALOG TODAY!
New Kits, New LPFM, New Cameras
NEW!
www.ramseykits.com

35 WATT LPFM STEREO TRANSMITTER NEW!

✓ 35W RF output, VSWR protected
✓ Automatic audio & power controls
✓ Digital synthesized PLL
✓ Full front panel control
✓ 110/220VAC, 12VDC operation

Whether your application is export or LPFM, the PX1 has you covered. From the over-rated continuous duty power supply & power amplifier to the 2 line vacuum fluorescent display, your station will be the easiest to setup and the most reliable for continuous operation. Full microprocessor controls provide a "virtual engineer". Check out www.highpowerfm for full details.

PX1 35W Professional FM Stereo Transmitter $1,795.95

ELECTROCARDIOGRAM HEART MONITOR

✓ Visible and audible display of your heart rhythm
✓ Re-usable sensors included; just like visiting the hospital!
✓ Bright LED "beat" indicator
✓ Monitor output for oscilloscope display NEW!

Enjoy learning about the inner workings of the heart while covering the stage by stage electronic circuit theory of ECG/EKG systems. Be heart smart and learn at the same time!

ECG1 Electrocardiogram Heart Monitor Kit $34.95
CECG Matching Case & Knob Set $14.95
AC125 110 VAC Power Adapter $9.95
ECGP10 Replacement Reusable Probe Patches (10-Pack) $7.95

PLASMA GENERATOR NEW!

✓ Generate 2" sparks to a hand held screwdriver!
✓ Build your own plasma balls!
✓ 25KV at 20 KHz from a solid state source!

Generate really impressive sparks, build your own plasma ball, light fluorescent tubes without wires! From a solid state source, generate over 25KV at 20KHz for the most dazzling displays!

PG13 Plasma Generator Kit $59.95
PS12 14VAC Output Power Supply $19.95

ION GENERATOR NEW!

✓ Generates negative ions with a blast of fresh air!
✓ 7.5KV DC negative, 400uA - that's a lot of ions!
✓ Steady state DC voltage, constant current, not pulsed!

Learn the basics of ion repulsion by building this ion generator! Creates a continuous blast of fresh air charged with a ton of ions. Perfect for pollution and air freshening; just smell those ions! Solid state wind generation; you'll be amazed!

IG7 Ion Generator Kit $59.95
AC125 110 VAC Power Adapter $9.95

TOUCH-TONE TONE GRABBER NEW!

✓ New-built-in RJ11 phone jack
✓ Large memory holds over 500 numbers
✓ Big bold 8 digit display, auto insertion of dashes
✓ New-output latch jack

Dialed phone numbers on the radio, repeater codes, control codes, anywhere touch-tones are used, you can read and store them! All new design for 2002. Capture those tones with the TG2!

TG2 Tone Grabber Tone Reader Kit $59.95
CTG2 Matching Case & Knob Set $14.95
AC125 110 VAC Power Adapter $9.95

RCA TO XLR AUDIO CONVERTER NEW!

✓ Connect consumer outputs to XLR inputs
✓ Left & right audio gain adjustments

So you're trying to connect consumer audio outputs with RCA connectors (unbalanced) to XLR (balanced) inputs. Always a problem...Not anymore with the R2XL1!

R2XL1 Unbalanced to Balanced Audio Converter Kit $49.95
CR2XL Matching Case & Knob Set $14.95
PWR25 12VAC Power Adapter $9.95

AUTOMATIC COLOR/BW IR CAMERA

NEW!

✓ Color during the day, IR B&W at night!
✓ Automatically turns on IR Illumination!
✓ Waterproof to IP57 standards!
✓ Black anodized housing with universal mount

Best of both worlds! This video camera is a waterproof COLOR camera during the day. When the light level drops, it automatically changes to B&W and turns on its built-in IR illumination, with 10 IR LEDs. Powered by 12VDC and terminated with a professional BNC connector. B&W only model also available if color is not needed. Both in heavy anodized black housing.

CCD309 Color/B&W IR Waterproof Bullet Camera $169.95
CCD308 B&W IR Waterproof Bullet Camera $109.95
AC125 110 VAC Power Adapter $9.95

MINI B&W CAMERA WITH IR ILLUMINATION

NEW!

✓ Built in IR illumination!
✓ Sees in total darkness!
✓ Black aluminum housing with swivel bracket

What a deal! This miniature B&W video camera has 6 high power IR LEDs built into it to provide illumination in total darkness! No need for external IR illuminators. Attractive black aluminum housing easily mounts at any angle with the built-in swivel bracket. Runs on 12VDC, and includes professional BNC output plug-in harness.

CCD303 Mini B&W IR Illuminated Camera $59.95
AC125 110 VAC Power Adapter $9.95

Check out all our other new cameras at www.ramseykits.com!

PROFESSIONAL FM STEREO RADIO STATION

✓ Synthesized 88 to 108 MHz with no drift !
✓ Built-in mixer – 2 line inputs and one microphone input!
✓ High power module available for export use
✓ Low pass filter for great audio response

Our FM100 is used all over the world by serious hobbyists as well as churches, drive-in theaters, and schools. Frequency synthesized PLL assures drift-free operation with simple front panel frequency selection. Built-in audio mixer features LED bargraph meters to make setting audio a breeze. The kit includes metal case, whip antenna and built-in 110 volt AC power supply.

FM100 Super-Pro FM Stereo Radio Station Kit $249.95
FM100WT 1 Watt, Wired Export Version $399.95

SYNTHESIZED FM STEREO TRANSMITTER

✓ All new design & features for 2002!
✓ Fully adjustable RF output NEW!

Our #1 kit for years has just gotten better for 2002! Totally redesigned, the FM25B has all the features you've asked for. From variable RF output, F connector RF output jack, line input, loop output, and more. Includes case, power supply, whip antenna, audio cables.

FM25B Synthesized FM Stereo Transmitter Kit $129.95

AND...OUR FAMOUS *MINI-KITS*

These are easy to build kits that can be used either stand-alone or as building blocks for more complex projects.

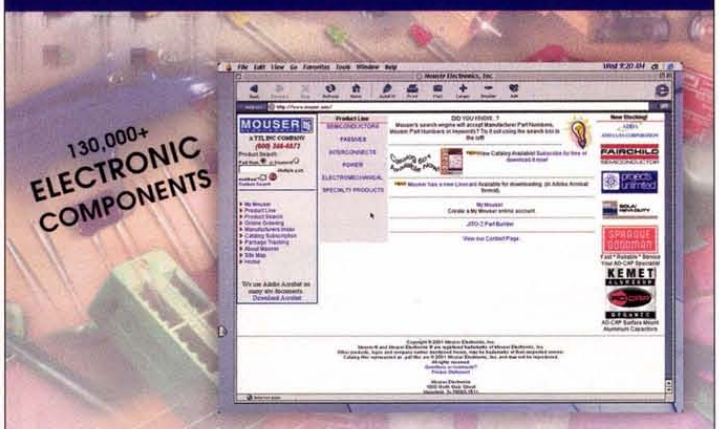
TS4 Tickle-Stick Shocker $9.95
BN9 Super Snoop Amplifier Kit $8.95
BL1 LED Blinky Kit $3.95
TD1 Tone Encoder/Decoder Kit $6.95
TT7 Touch Tone Decoder Kit $19.95
CPO3 Code Practice Oscillator Kit $9.95
UT5 Universal Timer Kit $8.95

RAMSEY
RAMSEY ELECTRONICS, INC.
793 Canning Parkway
Victor, NY 14564
716-924-4560
sales@ramseykits.com

Order Today! 800-446-2295
www.ramseykits.com

Circle #70 on the Reader Service Card.

SEARCH & BUY ONLINE
www.mouser.com

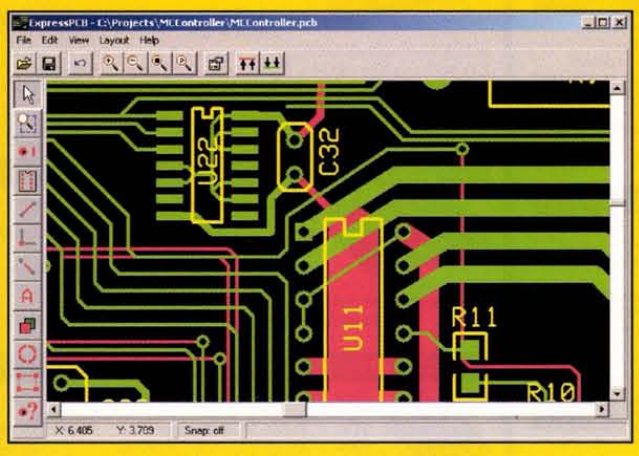


Semiconductors, Optos, LEDs, Lamps, Panel Meters, Wire, Cable, & Accessories,Connectors, Cable Assemblies, Sockets, Terminals, Resistors, Potentiometers, Thermistors, Varistors, Capacitors, Crystals, Oscillators, Resonators, Inductors, Transformers, Power Supplies, Switches, Relays, Circuit Breakers, Fuses, Batteries, Speakers, Audio Devices, Fans, Heat Sinks, Knobs, Hardware, Cabinets, Racks, Cases,Test Equipment, Tools, Prototyping . . . .

MOUSER ELECTRONICS

Circle #31 on the Reader Service Card.

$62 PCBs
And our layout software is FREE!



Download our FREE layout software
Design your two-sided plated-through PCB
Send us your design with just a click
Receive your boards in a few business days

Select our MiniBoard service and get three top quality 2.5" x 3.8" PCBs for $62 – shipping included!

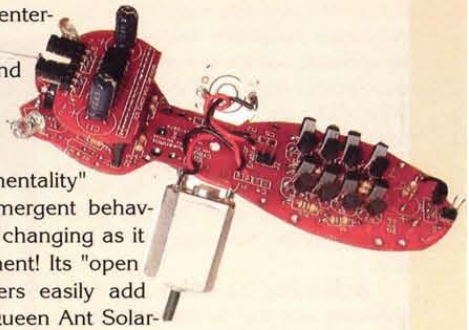
VISA expresspcb.com MasterCard

New Product News

Newest Insectoid Robot Kit Rules the Electronic Colony!

Mondo-tronics' Robot Store introduces the newest and largest member of the popular CYBUG family of robot kits — the CYBUG Queen Ant.

Bigger, expandable and evolvable, and with options for becoming solar-powered and even programmable, the Queen Ant kit provides a fun-to-build, educational, and entertaining experience for intermediate robot builders, and even beginners with some soldering experience.



The Queen Ant's "hive mentality" lets it exhibit fascinating "emergent behaviors" — actually learning and changing as it explores its robotic environment! Its "open architecture" design lets users easily add solar panels (with optional Queen Ant Solar-Wings add-on kit), or plug in a fully programmable BASIC Stamp microcomputer (available separately) that permits the creation and downloading of new behaviors from a PC. The robot's curvaceous bright red circuit board emphasizes its ominous arthropod look and immediately shows who rules the hive!

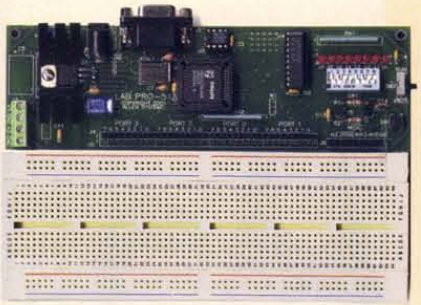
CYBUGs model living organisms, with behaviors and instincts designed into their circuitry. CYBUG robots have the ability to seek out their own "food sources" to keep themselves alive. Just as a honeybee seeks flowers for nectar, the CYBUG seeks out the brightest light source to find a meal of fresh electricity to recharge its batteries!

Fifteen-year-old Mondo-tronics, Inc., features a fascinating array of interactive robot kits, books, parts, tools, and more. The latest Robot Store Catalog can be downloaded as a .PDF file from the RobotStore.com web site.

For additional information, contact:

MONDO-TRONICS, INC.
1-800-374-5764 (9 AM-5 PM, Pacific)
WEB: **www.RobotStore.com**

LAB PRO-51 FLASH PROGRAMMABLE 8051 CARD WITH PROTOTYPING AREA



The LAB PRO-51 is a single board computer based upon the popular 8051 family of microcontrollers. The processor used on the board is the P89C51RB2BA, which has 16K bytes of Flash and 512 bytes of RAM. A major advantage of the 89C51, however, is its mechanism for in-system programming. On-chip Flash can be programmed by connecting the board to a PC serial port. This approach is referred to as "in-system" since the 89C51 remains installed on the LAB PRO-51 during programming.

A major design feature of the LAB PRO-51 is its prototyping area. The prototype area contains a large number of solder pads (.060 pad with .036 hole) placed on a .1 inch grid. User circuitry can be built and tested in this area. Board connectors are available to connect to the 89C51.

An optional solderless breadboard can also be purchased and

Continued on page 81

Classifieds

HAM GEAR

SATELLITE TV. Complete selection of C & Ku band equipment, **WWW.DAVESWEBSHOP.COM**

NEW ICOM IC-V8 VHF 5.5W handheld with full keypad, CTCSS/DCS encode/decode, tone scan, 1100mAh battery and charger + optional battery case $199.99. Easy modification for full TX 136-174MHz. To order call 1-800-977-0448 or visit http://www.nsiradio.com/

2.4GHz ATV — 8 channel TRANSMITTERS AND RECEIVERS. 35mW output power, 1 video channel, 2 audio. SMA connectors. NTSC/PAL compatible. Includes 1/4 wave rubber duck antenna. Standard frequencies are: 2398, 2405, 2412, 2416, 2420, 2428, 2435, 2442 MHz. Custom frequencies are available. See ad in this section for power amplifier. **$79/each for transmitter. $79/each for receiver**. EzATV. Visit our web-site for dealers or order on-line at www.4atv.com

1.2GHz ATV — 8 channel TRANSMITTERS and RECEIVERS. 75mW output power, 1 video channel, 2 audio. SMA connectors. NTSC/PAL compatible. Includes 1/4 wave rubber duck antenna. Standard frequencies are: 1250, 1255, 1260, 1265, 1270, 1275, 1280, 1290 MHz. Custom frequencies are available. **$79/each for transmitter. $79/each for receiver**. EzATV. Visit our web-site for dealers or order on-line at www.4atv.com

SUPER HIGH GAIN 14 dbi flat antenna with N or SMA connector tuned for 2.3-2.5 GHz. Use with 2.4GHz ATV 8 channel transmitter or receiver. **$179/ea**. SPECIAL PRICE. EzATV. Visit our web-site for dealers or order on-line at www.4atv.com

WANTED: ROCKWELL-Collins HF-80 equipment, 851S-1, 237B-3 log periodic, Collins literature. Jim Stitzinger 661-259-2011, 661-259-3830 (fax), jstitz@pacbell.net

2.4GHz POWER amplifier with power supply. 10-40 mW input, 1 (one) watt output with in-line SMA connectors and built-in heat sink. Approx. 2" x 2" x 5/8" size. Frequency range 2.3GHz-2.5GHz. **$189/each**. Compatible with all ATV product lines. See our website for more info on accessories and transmitter and receiver modules. EzATV. Visit our web-site for dealers or order on-line at www.4atv.com

BATTERIES/ CHARGERS

THE SMART BATTERY CHARGER for lead acid or gel cell batteries. Can be left connected to the battery **INDEFINITELY**, will not overcharge! Standard kit is 12V @ 1 amp. This kit is 100% complete. For the kit order #150-KIT at $59.95. For an assembled and tested unit, order #150-ASY at $79.95. CA residents add 7.75% sales tax. Add $6.50 per unit shipping. MC/VISA accepted. A&A Engineering, 2521 W. La Palma #K, Anaheim, CA 92801. 714-952-2114, FAX 714-952-3280. www.a-aengineering.com

REPLACEMENT BATTERIES. The lowest priced sealed lead acid rechargeable batteries for your battery backup systems, fire alarm and security systems, telephone systems, power tools, wheelchairs, medical equipment. 1-800-255-5545 or order online at **WWW.POWERQUALITYINC.COM**

CB — SCANNERS

CB MODIFICATIONS! Frequencies, books, kits, high-performance accessories, plans, repairs, amplifiers, 10-meter conversions. The best since 1976! Catalog $3. CBCI, Box 30655NV, Tucson, AZ 85751. www.cbcintl.com

240+ CHANNEL CB/HAM/FRS/COMMERCIAL radios: AM/FM/SSB/CW export/domestic: RCI, TEKK, Motorola, Uniden, Cobra, Alinco, Kenwood. Mics, antennas, linears, meters, mod books, manuals, schematics, night scopes, and tons more stuff! Catalog $3. MAXTECH, Box 8086, New York, NY 10150. 718-547-8244. www.pennycircus.net

COMPUTER HARDWARE

NewComputer.com COMPARES prices and detailed product specifications from top online sellers. Visit NewComputer.com to save time when shopping for new computer equipment.

1600MHz AMD Athlon XP computer, 40 gigabyte hard drive, DVD/CD-ROM drive, 1.44 floppy drive, 256MB memory, 64MB video, 4 USB, network card, 56K V.90 modem/voice/fax, sound, speakers, keyboard, mouse, programs, manual, warranty! $549. Add CD-ROM Writer, more! Visa/MasterCard/Amex/Discover, www.saveware.com TOLL FREE 1-877-882-0431.

DATA ACQUISITION: This very compact and low-cost kit will allow virtually any PC to be used for quick and easy data acquisition and control. It connects to any standard parallel printer port, and despite its tiny size provides eight analog inputs, four digital inputs, and four digital outputs. www.electronickits.com

EVERYTHING NEW w/warranty! Best prices. Motherboards with CPU 1,000MHz $195, custom configured systems. Pentium II systems from $195. Modems, multimedia kits, scanners, monitors, cases, $20. Hard drives sizes to 40 gigabytes. 540 megabyte $15. Sound adapter $10. Call 714-778-0450. Email: **cci@surfside.net**

1200MHz AMD Duran computer, 40 gigabyte hard drive, DVD/CD-ROM drive, 1.44 floppy drive, 128MB memory, 64MB video, 4 USB, network card, 56K V.90 modem/voice/fax, sound, speakers, keyboard, mouse, programs, manual, warranty! $449. Add CD-ROM Writer, more! Visa/MasterCard/Amex/Discover, www.saveware.com TOLL FREE 1-877-882-0431.

950MHz DURAN CPU & ATX Motherboard, Upgrade your old computer cheap! Includes CPU, FAN, motherboard with 64 megabyte video, sound, 56k V.90 modem. Ports include: 4 IDE UDMA 33/66/100, floppy, network, 4 USB, parallel, serial, PS2 mouse, PS2 keyboard, GAME. All cables, drivers/software CD-ROM disc, manual, warranty! $169. Visa/MasterCard/Amex/Discover, www.saveware.com, TOLL FREE 1-877-882-0431.

UsedComputer.com IS your online used computer equipment marketplace. Notebooks, desktops, printers, parts, free classifieds, 100's of dealers, quantity deals, information. Visit UsedComputer.com today.

MicroPricer.com® SHOWS price comparisons on new equipment, and appraisals on used equipment. Visit MicroPricer.com today.

PLAY BACKUP COPY of Sony Playstation 2 CDs or DVDs! Solder mod-chip's 5 wires into PS2, $49. Plug-in SBOX USB, solder in 1 wire $49. PlayStation PSX 5 wire $15. Game enhancer plug-in $25. Instructions, pictures on floppy. Use PC computer CD-ROM Writer to copy CDs to CDR. Visa/MasterCard/Amex/Discover, www.saveware.com, TOLL FREE 1-877-882-0431.

950MHz AMD Duran computer, 20 gigabyte hard drive, 52X CD-ROM drive, 1.44 floppy drive, 128MB memory, 64MB video, 4 USB, network card, 56K V.90 modem/voice/fax, sound, speakers, keyboard, mouse, programs, manual, warranty! $379. Add CD-ROM Writer, more! Visa/MasterCard/Amex/Discover, www.saveware.com TOLL FREE 1-877-882-0431.

DEC EQUIPMENT WANTED!!! We are buying DEC systems, boards, terminals, drives and peripherals. Also Scientific Micro Systems (SMS), CMD, Datability, Dilog, DSD, EMULEX, other DEC compatibles. Please contact us for a quote or fax/email your equipment list. We buy, sell, and trade. **KEYWAYS, INC.**, 937-847-2300 or fax 937-847-2350 or email buyer@keyways.com

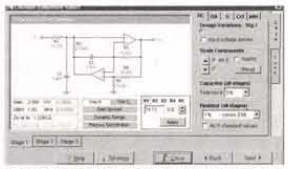
VGA TO COMPOSITE (NTSC) VIDEO CONVERTER — ULT-2000. Handheld. Powered from keyboard with S-video and RGB outputs, too. 3:1 zoom control with many extras. **$99/ea**. Matco, Inc., Schaumburg, IL, 1-800-719-9605, sales@matco.com or visit/order on-line at www.matco.com

COMPUTER SOFTWARE

KEYSTROKE LOGGER: This new software hides in the background on your computer allowing you to view what other people have been doing on the installed computer. Great for monitoring the children or the wife. www.spousewatcher.com

LIQUIDATION WINDOWS 95/98, Office suites $10-69. Windows companion $5. 1000, Norton AntiVirus $15. Fully configured 566 MHz systems $250. 714-778-0450.

FREE!!! CD-ROM and software disk catalog. **MOM 'N' POP'S SOFTWARE**, PO Box 15003-N, Springhill, FL 34609-0111. 352-688-9108. momnpop@gate.net



WWW.SCHEMATICA.COM FOR professional freeware and shareware. Active and passive filter design, 555 designer, linear simulators.

DEGREE ON A DISK!

EM FORMULARY

500+ formulas, conversions, and tables. Electronics, science, math. Practical, educational, and easy to use. Internet Special $19.95 + tax/ship. Now with PSpice examples. Order online, more info and sample screen at our web site.

ELECTRO SCIENCE APPLICATIONS
(310) 541-1862
www.esap.com

CAM & MOTION SW/HW: Z-trace PCB toolpath. Plotcam motion control. http://www.ddt-us.com

COMPUTER EQUIPMENT WANTED

WANTED: FOR historical museum, pre-1980 microcomputers, magazines, and sales literature. Floyd, VA 24091-0341 (540-763-3311/540-382-2935).

DEC EQUIPMENT WANTED!!! We are buying DEC systems, boards, terminals, drives and peripherals. Also Scientific Micro Systems (SMS), CMD, Datability, Dilog, DSD, EMULEX, other DEC compatibles. Please contact us for a quote or fax/email your equipment list. We buy, sell, and trade. **KEYWAYS, INC.**, 937-847-2300 or fax 937-847-2350 or email buyer@keyways.com

TEST EQUIPMENT

KENTRONIX TEST EQUIPMENT SPECIALS. Check our WEB site at **http://www.kentronix.com** for monthly specials. We are also looking to buy test equipment, coaxial and waveguide components, manuals, etc. Contact Brian at 732-681-3229 or FAX 732-681-3312. E-Mail: brian@kentronix.com

DEC EQUIPMENT WANTED!!! We are buying DEC systems, boards, terminals, drives and peripherals. Also Scientific Micro Systems (SMS), CMD, Datability, Dilog, DSD, EMULEX, other DEC compatibles. Please contact us for a quote or fax/email your equipment list. We buy, sell, and trade. **KEYWAYS, INC.**, 937-847-2300 or fax 937-847-2350 or email buyer@keyways.com

A-COMM ELECTRONICS: we buy and sell test equipment. http://www.a-comm.com 11891 E. 33rd Avenue, Aurora, CO 80010. Tel: 303-341-2283, fax 303-341-2293.

CABLE WIZARD Universal CableMeter & Fault Locator™, Model 321 quickly measures "open" length on most coax, twisted, semi-twisted, single-pair and multi-pair cable, on spools, in boxes, or already installed, also measures distance to "open" faults. For further information write or fax **CABLE DYNAMICS, PO BOX** 34594, Phoenix, AZ 85067, fax 623-931-6262.

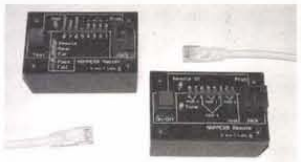
POCKET TESTBENCH, inexpensive RS-232 virtual instrument, with oscilloscope, logic analyzer, counter, and generator modes. **New WST-100**. www.oricomtech.com

CHECK OUR growing line of audio test instruments: data sheets, user guides, software. TDL Technology, Inc., www.zianet.com/tdl.

GIANT DIRECTORY ONLINE: Over 500 dealers in used test equipment, used semiconductor production equipment, surplus lasers, optics, vacuum equipment, etc. Test equipment auction and rental sites, US and foreign dealers, manual dealers, too! No registration or cookies. **www.big-list.com**

USED TEST equipment sale specials. Equipment on sale. Check this page to see what equipment we are offering at our lowest prices! www.calibration.com Instrument Repair & Rental Labs, Inc., 1-888-573-5468. Colorado 303-469-5335. Mail to sales@testequip.com

FEITEK PROVIDES repair, calibration and traceable certifications of test equipment. Free estimates. We buy, sell and trade all makes of test equipment. Visa and MasterCard accepted. Check out our inventory and specials at WWW.FEITEK.COM 2752 Walton Road, St. Louis, MO 63114, 314-423-1770.



ETHERNET CABLE tester. The Mapper8 provides complete connectivity testing of 8-wire modular cables as well as other cables. Displays both a quick pass/fail indication as well as details on how the cable is wired or mis-wired. Easy to build kit or assembled. **www.a-and-t-labs.com**

SECURITY

ALARMLAND.COM SECURITY devices for professionals. Motion detectors, panels, contacts, CCTV, and more. Fax your order to 732-840-1390.

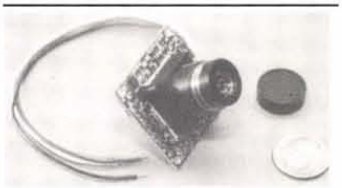
SURVEILLANCE-COUNTERSURVEILLANCE: I buy and sell used equipment. Steve 410-879-4035.

KEYSTROKE LOGGER: This tiny piece of hardware installs between your keyboard wire and computer in seconds. Then it logs all keystrokes, which you can view at your convenience. www.spousewatcher.com

COUNTER-SURVEILLANCE=$250 HR! Electronic eavesdropping is unbelievably widespread! Are you sure you're safe? Learn how others (without prior experience) earn **$250 HR** in the fascinating field of COUNTER-SURVEILLANCE! For FREE catalog call: **1-800-732-5000**. HTTP://WWW.SPY-CITY.COM

SURVEILLANCE EQUIPMENT: Micro video cameras, tele-recorders, counter-spy and more. Direct from manufacturer. Buy direct, why not! Check out our great deals at www.mjelectronics.com Phone 914-699-2294 open 7 days late.

2.4GHz WIRELESS transmitter /receiver kit. ASK-2008-TR, 8 frequencies uP controlled 2.300 to 2.481 MHz, video NTSC/PAL with 2 channels of audio for development testing. 12VDC/100 mA for both transmitter and receiver. Includes 2 rubber duck antennas. **$125**. Matco, Inc., Schaumburg, IL, 1-800-719-9605, sales@matco.com or visit/order on-line at www.matco.com



9 VOLT IR sensitive B/W high res 430 TVL camera with optional black low-profile swivel adjustable enclosure. Pin hole or Std. lens type. 6, 8, and 12mm lens are available. 1/3" CCD, 3.6mm/F2.0 lens included; works from **7.5-13 VDC**, highest voltage range in market. 0.08 lux, 1.27" x 1.27" x 0.5"D pinhole or 1" deep standard. **$49 each**. Enclosure: $8; optional lens: $18. Dealers welcome. Matco, Inc., Schaumburg, IL, 1-800-719-9605, sales@matco.com or visit/order on-line at www.matco.com

AS-1004 WIRELESS 2.4GHz, FCC approved. 2.4GHz transmitter & receiver with audio! Capable handling total of 4 wireless cameras, range: >300'. Built-in camera, 400 TV line. **Reduced price! $179/system**. Additional cameras, **$110/ea**. Matco, Inc., Schaumburg, IL, 1-800-719-9605, sales@matco.com or visit/order on-line at www.matco.com

CCD BULLET CAMERAS B/W & COLOR. AX-800 series, weather resistant high impact design with swivel bracket. Will work with Matco's scanning motor. 3/4" diameter x 3" long approx. B/W: 400 line/0.2 lux. **$79/each**. Color: 350 lines/2 lux, **$119/each** — price reduction. Matco, Inc., Schaumburg, IL, 1-800-719-9605, sales@matco.com or visit/order on-line at www.matco.com

SECURITY DISTRIBUTORS needed for our complete line of products. See our product features in the center color spread on page 43. **www.matco.com and call 1-800-719-9605**.

40 DAYS and 40 NIGHTS RECORDER. Time lapse, with remote, can be activated by either contact closure or continuous duty operation with standard T-120 tape. **Models from $349-$529**. Matco, Inc., Schaumburg, IL, 1-800-719-9605, sales@matco.com or visit/order on-line at www.matco.com

WEATHER RESISTANT OUTDOOR CAMERAS. WR-700 type, high impact tempered glass with stand. Black & white (430 lines), or color (420+ lines) available. Standard 3.6mm lenses with optional lenses of 6, 8, and 12 mm at $20 extra. **B/W $119/each. Color $179/each**. Small compact size with sun shield. Matco, Inc., Schaumburg, IL, 1-800-719-9605, sales@matco.com or visit/order on-line at www.matco.com

SEE THE NEW MATCO PRODUCT FEATURES AND PRICES in the color center spread on page 43.

5" AND 5.5" LCD high definition color monitors w/stereo. 960 x 240 pixels w/brightness and tint controls. Attractive enclosure with built-in speaker. Great for security or general purpose use. Both models have a small compact footprint, with an ultra-bright display, RCA inputs NTSC or PAL. Special price with regulated power **$249/each**. Matco, Inc., Schaumburg, IL, 1-800-719-9605, sales@matco.com or visit/order on-line at www.matco.com

16 CHANNEL MULTIPLEXER MUX-1600. Display 4, 8, and 16 video outputs directly on a TV or security monitor. This is the only device which allows full screen display of video on VCR playback (see 40 days and 40 nights recorder). Plenty of options including tilting, zoom, individual gain adjustments, etc. **Reduced price! $799/each. Special 4 channel version, MUX-400, $429/each**. Matco, Inc., Schaumburg, IL, 1-800-719-9605, sales@matco.com or visit/order on-line at www.matco.com

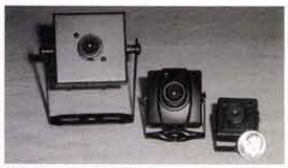
14" B/W high resolution SECURITY MONITOR. A standard 12" monitor is just too small for most applications. Attractive dark gray enclosure with audio and built-in speaker. 75 ohm termination switch for balancing with all types of CCD board cameras and other video inputs. **$139/each**. Matco, Inc., Schaumburg, IL, 1-800-719-9605, sales@matco.com or visit/order on-line at www.matco.com

QUAD PROCESSOR works with VGA monitor, QVS-104-CV. NTSC inputs, composite outputs as well as output for direct connection to VGA monitor. Saves cost of expensive high-grade security monitor, **$269**. Matco, Inc., Schaumburg, IL, 1-800-719-9605, sales@matco.com or visit/order on-line at www.matco.com

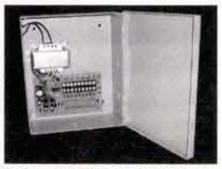
14" COLOR — high resolution SECURITY MONITOR w/4 channel switcher. High impact enclosure with modern front panel 4 channel video and audio switcher. High quality speaker built-in. Components purchased separately would exceed $500. Price slashed to **$249/each**. Matco, Inc., Schaumburg, IL, 1-800-719-9605, sales@matco.com or visit/order on-line at www.matco.com

INFRARED CAMERA for underwater or all-weather use, AX-808 (B/W) or AX-808-C (color). Designed for lake water to depths of 85 feet. Enclosed LEDs illuminates up to a distance of 20 feet. 12 volt operation. **Color $149, B/W $99**. Matco, Inc., Schaumburg, IL, 1-800-719-9605, sales@matco.com or visit/order on-line at www.matco.com

WIRELESS COLOR rechargeable 2.4GHz system, ASK-7003-TR. 150 foot range. Includes camera/transmitter, receiver and built-in battery pack with charging systems. Range 150 feet. **High volume seller! $159**. Matco, Inc., Schaumburg, IL, 1-800-719-9605, sales@matco.com or visit/order on-line at www.matco.com



COLOR & B/W board cameras w/cases, BX-120-LC (350 lines color) $89; BX-125-LC (380 lines color) $99, sub-miniature BX-123-AU (420 lines B/W with audio) $69. Matco, Inc., Schaumburg, IL, 1-800-719-9605, sales@matco.com or visit/order on-line at www.matco.com



CAMERA DISTRIBUTION Box, XF-250-DC/XF-250-AC. Connect your cameras directly to power source with screw terminals or plug in using a 2.1 mm connector. **Special price: $59 (DC version) and $49 (AC version)**. Can use pre-molded **50 foot video/power cable A-402-CA $15**. Matco, Inc., Schaumburg, IL 1-800-719-9605, sales@matco.com or visit/order on-line at www. matco.com

SATELLITE EQUIPMENT

SATELLITE TV. Complete selection of C & Ku band equipment, **WWW.DAVESWEBSHOP.COM**

LEARN HOW TO PROGRAM SATELLITE TV ACCESS CARDS. Send $24.95 for information packet to: KDV, PO Box 253, Buffalo, MN 55313.

SATELLITE REPORT: Find all the latest in satellite descrambling in this 54-page report. Lists all the cheapest and reliable sources for hacked cards and equipment. www.electronickits.com

WHOLESALE PRICING. Call, fax, or email for free catalog of over 1,600 items from satellites, cable, security, telephone wire and connectors. Quality pricing, fast shipping & great discount pricing. Your accessory connection. Call SkyMarketing @ 1-866-637-4965 or 219-489-7525. Fax: 219-489-2285. Email: skymark@fwi.com or visit us on the website at www.skymarktech.com

MILITARY SURPLUS ELECTRONICS

DOSIMETERS/RADIATION DETECTING KITS. New Canadian military surplus, now illegal to import due to recent change in Arms Control laws. Ten dosimeters, two chargers, two radiation meters w/carrying cases. Single D cell powers chargers and meters. Survival, nuclear war, nuclear power plants. $125 shipped US. Credit cards, checks. Dealers/quantities welcome. Steve 410-879-4035 or Steve@swssec.com

AUDIO — VIDEO — LASERS

STUDIO GEAR, antique radios, tubes, pro video, and unusual collectibles at WWW.bibbtek.com Call Tom @ 856-222-0636, fax to 856-222-0638 for printed list. Credit cards welcome.

SYNC-A-LINK UNIVERSAL video sync generators. Phone 918-479-6451, Email: rlc@sstelco.com **Sync-A-Link**, PO Box 4, Locust Grove, OK 74352.

STEREOSCOPER VR 3D generator. 918-479-6451, email: rlc@sstelco.com. **Sync-A-Link**, PO Box 4, Locust Grove, OK 74352 USA.

CABLE TV

CABLE REPORT: This 50 page report contains all the latest in how cable systems have been compromised. Including cheap and reliable sources for test chips and equipment. www.electronickits.com

CABLE PARTS! Computer parts. Call for great prices or visit us on the Web: HTTP://WWW.CB-Electronics.com or call 1-800-436-8630.

POSITIVE AND negative cable TV filters. www.gofilters.com 1-800-235-8080. Mike is back, give us a call. We can help in all situations.

CABLE PARTS for all makes and models, raw boxes at low prices. Call 1-888-817-8100. No NY sales. www.chipplace.com

RAW UNMODIFIED CONVERTERS. Thousands in stock. No order too big, no order too small. FORGET THE HYPE. $ ABSOLUTE LOWEST PRICES $. **Special this month on CFT 2000 series, DPV's, 8580's, and 8600's**. Call today 412-798-1644.

1-800-380-9530. SUPPLYING all your cable needs. Specializing in wholesale pricing on raw unmodified converters. Large quantities in stock ready to ship. Call for quantity pricing. Specials this month SA, Jerrold and Pioneer 1040C. Best customer service in the business.

CABLE CONVERTS
FOSS WAREHOUSE DIS.
289 SCHENCK ST., N. TONAWANDA, NY 14120
800-473-0506 • 800-488-0525 FAX
E/M FOSS@BUFFNET.NET
WEB PAGE: WWW.FOSSW.COM
NO DESCRAMBLERS

1-800-322-5286. SPECIALIZING in raw unmodified converters. We carry all manufacturers. Call for wholesale pricing.

TELEPHONE/FAX

PHONE MANAGER: This unit looks exactly like a Caller ID, except it records time, date, and length of all outgoing calls. www.spousewatcher.com

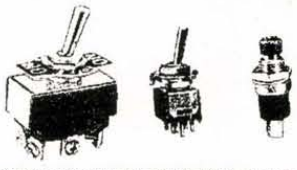
COMPONENTS

WANT TO Buy: ICs, military & aircraft relays, diodes, transistors, connectors, tantalum capacitors, electronic test equipment & most components. Hoffy Electronic Ent., E-Mail: Hoffie1165@aol.com 818-718-1165, FAX 818-341-5506.

PELTIER INFORMATION DIRECTORY ONLINE: Information site on Peltier devices (thermoelectric cooler/heater/generator modules). Tips, manufacturer directory, surplus sources, etc. Free. No registration. **www.peltier-info.com**

ELECTRONIC COMPONENTS, kits, test equipment, books, tools, and supplies for hams, hobbyists, and businesses. Many hard-to-find items like variable capacitors, vernier dials and drives, coil forms, magnet wire, toroids, more. **www.oselectronics.com**

RF TRANSISTORS, TUBES, TEFLON WIRE, SILVER MICA CAPS. 2SC2290, 2SC2879, SD1446, MRF455, MRF454, 2SC1969, 2SC2166, 2SB754, TA7222AP, 2SC2086, TA7222AP, MRF247, MRF317, SAV7, etc., 4CX250B, 4CX1000A, 4CX1500B, 3CX400A7/8874, 3CX3000A7, 4CX400A, 572B, etc. Teflon wire specials 1,000 ft. 16 gauge .15 cents ft., 1,000 ft. 18 gauge .14 cents ft., silver mica caps, resistors, see our catalog for other products. Westgate 1-800-213-4563.



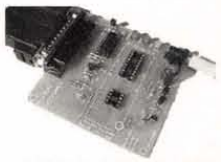
SWITCH SUPERMARKET large variety toggle, rotary, LEDs bipolar 2 & 3 leads, grain of wheat, free list. Fertik's, 5249 "D" St., Philadelphia, PA 19120. Ph/fax 215-455-2121.

MATCO WILL design, engineer, and develop a 2.4GHz wireless 8 channel solution for your remote applications. FCC approved. Matco, Inc., Schaumburg, IL 1-800-719-9605. E-Mail: nsales@matco.com Web site www.matco.com

ELECTRONIC COMPONENTS. 24LC256, PIC16C56, AT90S2313, AT90S8515. Call for price 1-800-990-4160.

OFF THE shelf DIN series or custom designed VS series AC/DC **SOLID STATE RELAYS** and DC/DC **CONVERTERS** available for your application. Contact: info@vsholding.com or 502-933-8660.

MICRO CONTROLLERS



PIC & ATMEL PROGRAMMERS from $15.95 and $29.95! Visit www.electronics123.com for complete details. Amazon Electronics, Inc. Toll free 1-888-549-3749.

PIC PROGRAMMERS: Several different programmer kits that you can build yourself all the most popular PIC and Atmel chips. www.electronickits.com

PIC DESIGNS DONE CHEAP! Midwest Micro-Tek, a leader in 8 and 16 bit controller design, is now offering their design services for PIC designs at a low price of $60/hr for design, routing, and programming. For more info call 605-697-8521. www.midwestmicro-tek.com

TEXAS INSTRUMENTS TMS370 "Family" microprocessor starter kit, $150; TMS370 CDT w/PACT daughterboard sys. kit $150; $10 S&H per item, email Tmkpe@aol.com, Terry M. Knudson, P.E., 1228 W. Scyene Rd, Suite 212, Mesquite, TX 75149, 972-216-0961.

ANTIQUE ELECTRONICS

WANTED: FOR historical museum, pre-1980 microcomputers, magazines, and sales literature. Floyd, VA 24091-0341 (540-763-3311/540-382-2935).

DEC EQUIPMENT WANTED!!! We are buying DEC systems, boards, terminals, drives and peripherals. Also Scientific Micro Systems (SMS), CMD, Datability, Dilog, DSD, EMULEX, other DEC compatibles. Please contact us for a quote or fax/email your equipment list. We buy, sell, and trade. **KEYWAYS, INC.**, 937-847-2300 or fax 937-847-2350 or email buyer@keyways.com

AVIATION ELECTRONICS

KINGSLEY HOTSTAMP foil machines for imprinting leather, etc., and electrical wire marking. Manual or automatic machines and type available. Call 760-749-0239. bjnash@n2.net

PUBLICATIONS

BASIC STAMP 2 users: "Inside the BASIC Stamp II" tells how the PBASIC interpreter works, how code is stored in EEPROM, how to optimize code for space and speed. 160 pages, 50 illustrations, many examples. See http://members.aol.com/stamp2book Send $29.95 check or money order (US funds) to Brian Forbes, 147 Flying Cloud, Foster City, CA 94404-1301.

WWW.COVERTBUG.COM SURVEILLANCE DESIGN BOOK. 117 production schematics, all types of transmitters. Room, telephone, battery, and mains powered. Countersurveillance chapter with equipment. Visit website for details. Brochure. $40 + $6 S&H. **Sheffield Electronics**, PO Box 377940, Chicago, IL 60637. 773-324-2196. sheffield@covertbug.com

Subscribe to Nuts & Volts
www.nutsvolts.com

ROBOTICS

ARobot KIT from Arrick Robotics uses the BASIC Stamp II. Quality metal construction. Easy to assemble and very expandable. $235. http://www.robotics.com/arobot

EASY RC. Preprogrammed PIC accepts standard RC pulses and sends control signals to motor controller for direction and proportional speed control. Single channel or dual channel with mixing available. Info: 570-735-5053. http://www.diverseelectronicservices.com email: carl@diverseelectronicservices.com

MOTOR CONTROLLERS, PWM, 12V, 24V, 35A, many features from $40 plus S&H. Info: 570-735-5053. Details: http://www.diverseelectronicservices.com Toll free orders (only) 1-888-314-6998.

ROBOT WEAPONS control, PIC controlled circuit boards use standard RC signals to control any device up to 10A. Selectable momentary or latched. Control motor direction. Four models control from 1 to 3 devices. Diagnostic LEDs. Input 9 to 24 VDC. 5V output for RC receivers. 570-735-5053. www.DiverseElectronicServices.com

ROBOT KITS: Over 30 complete robot kits from beginner to advanced at www.electronickits.com

MOBILE ROBOT PLATFORM. Want to build a powerful robot but don't know where to start? This 15" x 19" x 10" robot platform includes chassis body with four compartments, two-speed high-torque motors, large 8" drive wheels, and 6" rear swivel wheels. Plenty of surface area for adding sensors, cameras, etc. Only $229 assembled, $199 unassembled. Ph 321-757-9280 or online: <http://www.kadtronix.com/>.

12V BATTLEBOTS MOTOR & WHEEL. Need a drive system for your robot? This high-torque motor and 8 inch wheel are the answer. Motor has worm-gear drive and two speeds: 106 rpm @ 4A, 41 rpm @ 1A. Three mounting holes for easy installation. Wiring instructions included. Only $59 plus S&H. Ph: 321-757-9280 or online: <http://www.kadtronix.com>.

PIC-BASED controller boards and coprocessors for small bots, singleboard computers and other prototyping components. www.oricomtech.com

Build Your Own Combat Robot
by Pete Miles
and Tom Carroll
Build a powerful and invincible robot — for full blown competition or just for fun — using this authoritative resource. **$24.99**

Order from ***Nuts & Volts*** 1-800-783-4624 or www.nutsvolts.com

CNC

AFFORDABLE CNC MACHINES

Simple to Use

Run From Any Version of Windows®

www.flashcutcnc.com

Automated Machine Tools to Produce

- Panels
- PCB Prototypes
- Chassis/Housings
- Any 3D Part

FLASHCUT CNC ™

1263 El Camino Real, Menlo Park, CA 94025
4949 St. Elmo Avenue, Bethesda, MD 20814
Tel 888-883-5274 Fax 650-853-1405

PLANS — KITS — SCHEMATICS

ELECTRONIC KITS: Hundreds of electronic kits and projects. Where else except www.electronickits.com

AMAZING KITS, remote control, motor controllers, PIC experimenter boards. Fun and educational. Quality guaranteed. www.dlrkits.com

PLANS, BOOKS, kits, surplus, AM/FM/SW broadcasting supplies. Online ordering at **www.kenneke.com**

ROBOT DESIGN MANUAL. Describes how to design and build a powerful mobile robot. The design manual gives detailed information regarding platform construction, motor installation, and electronic controller. Includes parts lists, schematic, and BASIC Stamp object code included on disk, ready for loading to a Parallax BS1 Stamp. Only $29. Ph: 321-757-9280 or online: <http://www.kadtronix.com>.

HIGH PERFORMANCE ELECTRONIC KITS. A and T Labs offers a line of exceptional audio, test, and other electronic kits and products. Designs that distinguish themselves from their commercial alternatives with superior performance, functionality, and quality! **www.a-and-t-labs.com**

15MHz FUNCTION GENERATOR $21.50, 80C320 MICRO-CONTROLLER $21.50. WWW.CGMICRO.COM

4,000+ SCHEMATICS reverse engineered and piled into 21 catalogs. This month we are featuring lighting and medical on our web site. We also do contract reverse engineering. **Bomarc Services**, Box 1113, Casper, WY 82602. 307-234-3488. bomarc.org rollo@trib.com

MISCELLANEOUS ELECTRONICS FOR SALE

ANAHEIM WIRE PRODUCTS. DISTRIBUTOR OF ELECTRICAL WIRE AND CABLE since 1973. Items available from our stock: Hook up wire, Automotive primary wire, GXL, SXL, Plenum cable, Teflon wire, Multi-conductor cable, Irradiated PVC, SO-CORD, Mil-Spec wire, Building wire, Welding cable, Battery cable, Telephone wire, Shrink tubing, Cable ties, Connectors. Wire cut & strip to specs. If interested, please call **1-800-626-7540**, FAX: 714-563-8309. Visa/MC/Amex. SEE US ON THE INTERNET: http://www.anaheimwire.com OR E-Mail: info@anaheimwire.com

Electronics Manufacturing Technology a div. of Ledvision

EMT Electronics Manufacturing Technology

ISO-9001 Compliant

www.pcboardsinc.com

Bare Printed Circuit Boards
- Design & Layout
- Single, Double & Multi-Layer

Automated Assembly
- SMT & Thru-Hole
- Prototypes Thru Production
- Product Engineering
- Final Assembly & Test

303 Sherman Ave., Ackley, Iowa 50601
(641) 847-3902 Fax: (641) 847-3889
sales@pcboardsinc.com

HARD-TO-find parts: PTV screens, modules, chassis, flybacks, tuners, tubes, for all brands. Manuals. 478-272-6561. Scarborough TV, 1422 Old River Road, East Dublin, GA 31027. scarboroughstv@pcnow.net

SELLING ELECTRONICS parts business! Over 1,000,000 components/assemblies. 30 year inventory (1970-2000). Consumer, industrial, military, medical parts. Call Jobe Electronics, Ph 618-993-6340 Marion, IL 62959.

TEXAS INSTRUMENTS DSP (Digital Signal Processing) TI Code Composer Studio IDE C5000 or C6000, $150 Each. DSP C54x Starter Kit $75. TMS320C2xx Evm kit $125, DSP C2xx motor control w/motor $225. $10 S&H per item, email Tmkpe@aol.com, Terry M. Knudson, P.E., 1228 W. Scyene Rd., Ste 212, Mesquite, TX 75149, 972-216-0961.

RS485/422/232/TTL

ASC24T $45

- Converters
- Repeaters
- Fiber Optics
- Digital I/O
- Multidrop RS232
- Custom Units
- Auto TX Enable

Extensive Interface Product Line
RS232 "Extension Cords"
Up to 115.2 Kbps, 4000 ft. ++
Large Multidrop Networks.
Isolated Units. Smart Units
Remote Relay "Extension Cords"

Call the RS485 Wizards at
(513) 874-4796

RES = R.E.Smith
www.rs485.com

LedVision Holdings, Inc.

LEDVISION

Scrolling L.E.D. Signs
- Wireless Keyboard
- Includes Windows Software
- Text & Graphics
- Super Bright Multi-Color
- Clock Functions & Scheduler
- Real Time (ASCII) Mode
- 16K Flash Memory
- RS-232 & RS-485 Serial Ports

303 Sherman Ave., Ackley, Iowa 50601
(641) 847-3902 Fax: (641) 847-3889
sales@ledvision.com
www.ledvision.com

SENIX ULTRA-U ultrasonic distance sensor. Used just a few hours. Cost $500 new. Will sell for $180. 1-800-760-6874.

ZENITH KEYBOARD terminal. 63 keys, DECVT-52 compatible, TTL I/O, RS-232 serial and Centronics parallel ports, composite video output, built-in modem, unused in original box with manual and schematics. $35. 619-449-9040, or order online at www.CBMart.com.

SOLAR-POWERED FAN HAT. Baseball type hat with solar powered fan. Great for sports fans, golfers, etc. Available in red or blue. $19 plus $2.00 shipping. CA residents add 7.75% sales tax. Visa/MC/Disc/Amex OK. H.T. Orr Computer Supplies, 249 Juanita Way, Placentia, CA 92670. 714-528-9822, 1-800-377-2023, FAX 714-993-6216.

HONEYWELL TEMPERATURE recorders. Several. From single channel to 30 channels with color printing. Call, fax or email with your requirements. Peter 248-669-3604 Fax: 248-669-3411. stratigiccontrol@hotmail.com

MISCELLANEOUS ELECTRONICS WANTED

WANTED: BALANCING machines & vibration analyzing equipment manufactured by the following: Spectral Dynamics, Hofmann, Bentley Nevada, Schenck, IRD Mechanalysis, Gishott. Contact Mike Park at E.T. Balancing, 12823 Athens Way, Los Angeles, CA 90061. 310-538-9738, FAX: 310-538-8273.

WANTED: TUBES, radios, transmitters, receivers, gyros, bearings, connectors, relays, lamps, synchros. Hyness Company, 709B Delair Road, Monroe Twp., NJ 08831. Phone: 609-395-1116, FAX 609-395-1117.

DEC EQUIPMENT WANTED!!! We are buying DEC systems, boards, terminals, drives and peripherals. Also Scientific Micro Systems (SMS), CMD, Datability, Dilog, DSD, EMULEX, other DEC compatibles. Please contact us for a quote or fax/email your equipment list. We buy, sell, and trade. **KEYWAYS, INC.**, 937-847-2300 or fax 937-847-2350 or email buyer@keyways.com

Classified Ad Instructions

TYPE or PRINT your **ELECTRONICALLY RELATED** ad copy **CLEARLY (not all caps)** on a separate piece of paper. Spell out words when submitting handwritten copy. Calculate the number of words and multiply it by the appropriate rate (see RATE PER WORD section). Include any charges for **bold** and/or CAPPED words, any artwork costs that would be applicable, and/or costs for boxing your ad (explained below). Choose the appropriate classification for your ad(s) to appear in (see below). If no classification is indicated, it will be placed in Misc. Electronics or wherever we deem most suitable. **Enclose your name, address, phone number, and *Nuts & Volts* account number from your mailing label** (if available) for identification purposes. Include full payment — **CLASSIFIEDS RUN ON A PRE-PAID BASIS ONLY** — and mail your completed order to:

NUTS & VOLTS MAGAZINE
430 Princeland Ct., Corona, CA 92879

RATE PER WORD

The ad rate for **current PAID subscribers** is **60¢** per word. All others pay **$1.20** per word. There is a **$9.00 minimum** charge per ad per insertion.

BOLD WORDS AND/OR CAPS

Words to be set in **bold** or CAPS are each 10¢ extra PER WORD. **BOLD CAPS** are 20¢ extra per word. The first two words of each ad are bold capped at no charge. Indicate bold words by underlining. Words normally written in caps (e.g., IBM) and accepted abbreviations such as VAC or MHz are NOT charged as all cap words. Use a two-letter abbreviation for states.

PHOTOS, DRAWINGS

A photo or drawing may be run at the top of your classified ad for an additional **$10.00** (1" depth max.) for camera-ready art. No wording is allowed in this area.

EMAILING/FAXING AD COPY

You may email or fax in ad copy or changes before the closing date (5:00pm on the **1st**) using MasterCard or Visa. Include credit card expiration date, the name that appears on the card, a daytime phone number, and your *Nuts & Volts* account number. Email ad(s) to classad@nutsvolts.com or fax to 909-371-3052. Ads without credit card information will not be listed as received until payment is received in full. **WE DO NOT CALL, EMAIL, OR FAX BACK VERIFICATION OR QUOTES OF EMAILED AND FAXED-IN ADS.** For verification of emailed or faxed-in ads, please call 909-371-8497.

DEADLINE

Prepaid ads received by 5:00pm on the **closing date (1st of the month)** will appear in the following month's issue. Ads postmarked through the **1st**, but received after the closing date, will be placed in the next available issue. No cancellations or changes after the 1st. Cancellations and changes must be submitted in writing.

IMPORTANT INFORMATION

All classified ads are running copy only. No special positioning, centering, dot leaders, extra space, etc. is allowed. All advertising in *Nuts & Volts* is limited to **electronically related items ONLY**. All ads are subject to approval by the publisher. We reserve the right to reject or edit any ad submitted. We do not take ad copy or changes over the phone. We do not bill for classified ads. Repeat ads or ads run in multiple classifications within the same issue are allowed. Paid subscribers may run ads at the 60¢ rate only through their subscription expiration date. **NO REFUNDS**. Credit only. No credit for typesetting errors will be issued unless you *clearly* print or type your ad copy.

Choose a category for your ad from these classifications.

10. Ham Gear
20. Batteries/Chargers
30. CB/Scanners
40. Music & Accessories
50. Computer Hardware
60. Computer Software
70. Computer Equipment Wanted
80. Test Equipment
85. Security
90. Satellite Equipment
95. Military Surplus Electronics
100. Audio/Video/Lasers
110. Cable TV
115. Telephone/Fax
120. Components
125. Microcontrollers
130. Antique Electronics
135. Aviation Electronics
138. Thermocouple Welder
140. Publications
145. Robotics
148. CNC
150. Plans/Kits/Schematics
155. Manuals/Schematics Wanted
160. Misc. Electronics For Sale
170. Misc. Electronics Wanted
175. BBS & Online Services
180. Education
190. Business Opportunities
200. Repairs/Service

UNITEK MODEL DP-125 or **DP-250** welder power supplies **WANTED**. 608-831-3443, fax 608-831-1082, ask for Everett.

BBS & ONLINE SERVICES

EDUCATION

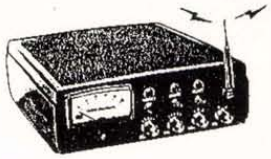
MAGICIAN IS available to solve your RF problem. I will teach you in my laboratory how to do it. Young engineers and technicians are welcome. SMT prototyping up to 3GHz for customers. Minaret Radio, John Horvath ph: 909-943-3676. Ask for my resume.

FREE CONTROL and embedded systems tutorial, www.learn-c.com Optional interface board for hands-on learning. Eight 8-bit AD, two 8-bit DA, 27 digital lines and more. Bare board only $20. Kits and assembled available.

BUSINESS OPPORTUNITIES

AFFILIATES WANTED: If you have a website you can earn a 10% commission for every person that you refer to our site. See complete details at www.spousewatcher.com

SALES PART/full time no investment. ISE, wholesale liquidator of electronics since 1978. Make big money sell consumer, industrial surplus. www.isesurplus.com 866-950-5565.



COUNTER-SURVEILLANCE=$250 HR! Electronic eavesdropping is unbelievably widespread! Are you sure you're safe? Learn how others (without prior experience) earn **$250 HR** in the fascinating field of COUNTER-SURVEILLANCE! For FREE catalog call: **1-800-732-5000**. HTTP://WWW.SPY-CITY.COM

REPAIRS — SERVICES

(E)EPROM PROGRAMMING done quickly and economically. One day turn around typical. Simple copy $3 per device. Also prototyping, design, and consulting services available. Call or send SASE to: **Luzer Electronics, 4023 North Bayberry, Wichita, KS 67226. 316-687-2127, FAX 316-687-3103.**

MECH ENGINEERING CONSULTING: machine design & packaging from conceptual to manufacturing: detailing, bill of mat'l, part procurement, & proto build. **GSC, MECHANICAL ENGINEERING SERVICES 508-339-7837** or email: SECGSC@aol.com. (Ask for Greg.)

WELD ALUMINUM WITH PROPANE! EZ, INEXPENSIVE, STRONG. DETAILS: WEEKS, 36 CAROLINA ST., TAYLORS, SC 29687. 1-800-547-WELD(9353) FAX 864-244-6349. http://www.durafix.com

Easy-to-Use Seetron Serial LCDs

Interface a sharp LCD display to your BASIC Stamp® or other microcontroller project with ease. No-solder wiring harnesses and easy mounting kits available too. See www.seetron.com today.

- 3.2 x 1.4 in. supertwist LCD
- 2400/9600 baud serial
- Low (≈2mA) current draw
- Popular for use with BASIC Stamps®

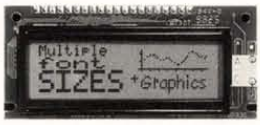
$45 BPI-216N

- 3.2 x 2 in. backlit LCD
- 1200-9600 baud serial
- Advanced protocol, 4 switch inputs
- EEPROM for configuration settings
- Favorite for OEM applications

$49 ILM-216L

- 3.2 x 1.4 in. graphics LCD
- 2400/9600 baud serial
- Font and 15 screens in EEPROM
- Easily draw points, lines, screens

$99 SGX-120L



- 3 x 2 in. supertwist LCD
- 1200-9600 baud serial
- ESD-protected, 4x4 keypad input
- Store up to 95 screens in EEPROM

$119 TRM-425L

Scott Edwards Electronics, Inc.
1939 S. Frontage Rd. #F, Sierra Vista, AZ 85635
phone 520-459-4802 • fax 520-459-0623
www.seetron.com • sales@seetron.com

More displays available, including bright VFDs. See www.seetron.com

Circle #42 on the Reader Service Card.

TECH FORUM

Continued from page 18

[2025 - FEB. 2002]

I have a Commodore MPS-803 friction feed printer. I heard that the printer can be converted to a traction feed type. How do I do this?

The Commodore MPS-803 can be converted from a friction-feed to a tractor-feed with the use of a retro assembly called a TU-803, that was offered by Commodore.

The unit attached to the printer by removing two small rectangular pieces (about 1/2" wide and 1" long) just above the carriage bar.

The unit had two extensions on the underside that inserted into the slots, snapping onto the shaft inside. Pushing back, it snapped down and the gear meshed with the gear on the side of the paper advance wheel.

To find one may not be easy, since Commodore is no more, but they are out there. Try your area hamfests, talking to the vendors and dealers of old equipment and most of all, with the amateur operators themselves. You would be surprised how many have some Commodore equipment stashed in garages, closets, and store rooms gathering dust. If not, they may know where. Some may even give it to you if you go get it. But you have to ask around.

When you find one, check it over, they are mostly plastic and don't take too well to rough handling.

Verl Wooters
Centralia, IL

[1029 - JAN. 2002]

I have some old ceramic resonators or crystals, I'm not sure. How can I find their frequency?

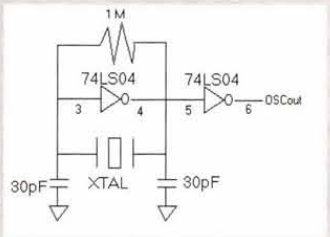
#1 Two steps are needed to determine the frequency of a crystal:

1. Cause the crystal to oscillate at it's resonant frequency.

2. Measure the frequency of oscillation.

There are several ways of performing each of these steps, based on the equipment that you have at hand and, to a lesser extent, on the frequency range of the crystal. You may need more than one technique to separate a wide range like 32KHz and 100MHz!

Step one is done by placing the crystal between XTALin and XTALout of a chip that oscillates, such as a Scenix processor (rated 0-50MHz), or by building a stand-alone oscillator circuit.

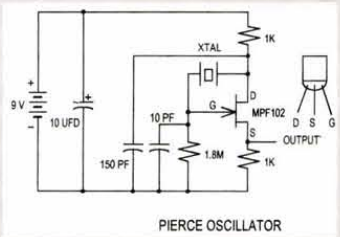


Measuring the frequency can be done directly with a frequency counter, or indirectly with a scope or computer program. The oscilloscope will measure the time from rising edge to rising edge. The frequency can then be calculated by freq=1/time. For example, 1/20ns=50MHz, 1/1uSec=1MHz.

The program method can use a processor running from the unknown crystal and waiting a known number of instruction cycles before toggling an I/O pin, or can run with a faster crystal and count how many cycles are executed between sucessive toggles of an I/O pin. The latter is very effective for measuring crystals of 10MHz or slower.

Larry Barry
via Internet

#2 One of the easiest ways to determine the frequency of a crystal is to place it into a Pierce oscillator circuit and check the output waveform at the source of the FET with a scope or frequency counter, as shown in the diagram.



PIERCE OSCILLATOR

For some frequencies, the Pierce oscillator circuit might need trimming of the two capacitors, 10 pF and 150 pF.

A Pierce crystal oscillator has no tuning elements, and will oscillate over a wide range of frequencies. The crystal will oscillate at its fundamental frequency. Once the fundamental frequency is known, the crystal can be placed in a conventional oscillator circuit such as a Hartley or Colpitts with a resonant tank circuit tuned to the third of fifth harmonic. This will permit operation of the crystal at higher frequencies.

schematic scanned graphics pierce.bmp

Anthony Caristi
Waldwick, NJ

#3 Figure 1 is a Colpitts circuit I built years ago (and still use). A milliammeter at TP will indicate crystal activity.

Figure 2 is a Pierce circuit that I have not built, but should work over the range of 455 KHz to 10.7 MHz.

For both circuits, the value of B+ is not critical, 5-15 volts will work. Any two-leaded crystal or resonator will work, but overtone crystals will oscillate at the fundamental frequency. I think a three-leaded resonator (filter) will oscillate in these circuits, but have not tried it. The 900 numbers are RadioShack.com part numbers.

Russell Kincaid
Milford, NH

Figure 1

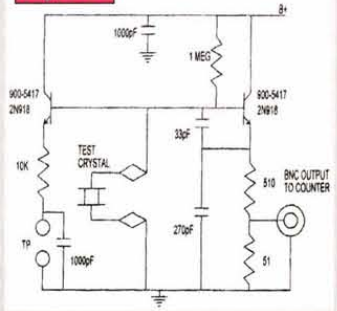
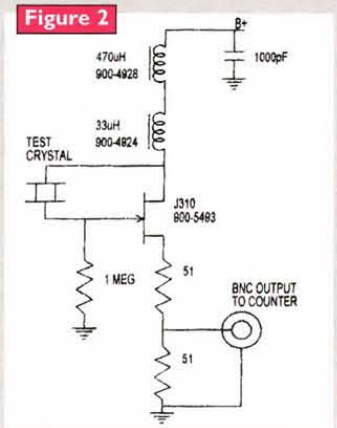


Figure 2



UPGRADING VIDEO SURVEILLANCE AT YOUR COMPANY?

www.cctvpros.com

Discount Prices on Major Brand CCTV Products
20 years of friendly, knowledgeable service!

(800) 486-2288 info@cctvpros.com

THEFT & TAMPERING & UNAUTHORIZED REMOVAL
can be controlled!

Equip your mobile 2-way radios with the **ET-850 Locking Slide Mount**. A standard mounting platform, simple and effective. Stop blind fumbling to release hidden fasteners. Easily transfer radios from vehicle to vehicle but prevent unauthorized transfers. With a black powder coat finish, it is at home in a luxury car or a delivery truck. Use in the office, too.

Fits most mobile 2 ways on the market today.

(Ask about our new Double Stack Slide Locking Mount and our maximum security Radio Cages™)

E TIP, Inc.
Addison, IL 60101 USA
(800) 530-5064 FAX (630) 530-5019
www.etipinc.com | sales@etipinc.com
(E TIP is a small, Veteran Owned Business)

Circle #50 on the Reader Service Card.

Events Calendar

Continued from page 34

JUNE 8

MO - MACON - Hamfest. Macon County, Nemo, Schuyler, & Tri-County ARCs, 660-385-3629. Email: n0pr@arrl.net Web: www.qsl.net/n0pr/hamfest.html
PA - BLOOMSBURG - Convention. Columbia Montour ARC, 570-784-2299. Email: n3kyz@jlink.net Web: http://www.qsl.net/cm-arc
TN - KNOXVILLE - Hamfest. Cokesbury Center, 9915 Kingston Pike. Knoxville RAC, 865-670-1503. Email: d.bower@ieee.org Web: www.w4bbb.org

JUNE 9

IL - EFFINGHAM - Hamfest. National Trail ARC, 217-342-3054 (M-F 9am-5pm).
IL - GRANITE - Hamfest. Southwestern IL College Campus, IL Rt. 203. The Egyptian RC, 618-655-1232, email: w9pat@arrl.net. 618-667-4592, email: kb9ail@arrl.net. 618-656-0905, email: k2kfw@arrl.net Web: www.w9aiu.org
IL - WHEATON - Hamfest. Six Meter Club of Chicago, 708-442-4961. Email: wa9fih@arrl.net http://cyberconnect.com/orion/hamfest.htm
KY - INDEPENDENCE - Hamfest. Northern Kentucky ARC, 513-797-7252. Email: n8jmv@arrl.net

JUNE 14-15

NE - SOUTH SIOUX CITY - Convention. 3900 Club, 712-252-4107 (10am-5:30pm). Email: tands@pionet.net Web: http://www.3900club.com

JUNE 15

NJ - DUNELLEN - Hamfest. Columbia Park. Raritan Valley RC, Inc., 732-469-9009, email: wb2njh@aol.com, or 732-968-7789
OH - MILFORD - Hamfest. Milford ARC, 513-753-5066. Email: kb8snh@cs.com

JUNE 16

MA - CAMBRIDGE - Hamfest. MIT Radio Society/Harvard Wireless Club/MIT UHF Repeater Assn., email: w1gsl@mit.edu (617-253-3776 9am-5pm.) Web: http://web.mit.edu/w1mx/www/swapfest.html

JUNE 28-29-30

CA - FERNDALE - Convention. Humboldt ARC, Redwood ARC, Farwest Repeater Assn., & Southern Humboldt ARC, 707-442-3866. Email: conven@humboldt-arc.org Web: www.humboldt-arc.org

JULY 2002

JULY 4

PA - HARRISBURG (BRESSLER) - Hamfest. Harrisburg RAC, 717-938-8249. Email: k3pd@arrl.net Web: http://hrac.tripod.com/July4.htm

JULY 7

IL - PEOTONE - Hamfest. Kankakee Area Radio Society, 815-933-1323. Email: karsfest@yahoo.com Web: www.w9az.com
PA - WILKES-BARRE - Hamfest. Murgas ARC, 570-824-7579. Email: n3wpg@juno.com Web: www.qsl.net/k3ytl

JULY 12-13-14

UT - BRYCE - Convention. Utah Hamfest Committee, 801-547-9218. Email: jimkatpa@aol.com Web: www.utahhamfest.org

JULY 13

GA - GAINESVILLE - Hamfest. Lanierland ARC, 770-967-6364. Email: w4tl@arrl.net Web: www.lanierlandarc.org/hamfest.htm
TN - CLEVELAND - Hamfest. Cleveland ARC, 423-472-1660. Email: bgault@wingnet.net

JULY 14

PA - KIMBERTON - Hamfest. Mid-Atlantic ARC, 610-667-1650. Email: sflink@juno.com Web: www.marc-radio.org/hamfest.html
PA - PITTSBURGH (NORTH HILLS) - Hamfest. North Hills ARC, 412-486-1681. Email: aa3ta@bellatlantic.net Web: www.nharc.pgh.pa.us

JULY 19-20

OK - OKLAHOMA CITY - Oklahoma State Fair Park, Oklahoma Bldg., intersection I-40 & I-44. Central Oklahoma Radio Amateurs, Inc., www.geocities.com/heartland/7332

JULY 20

NY - ALEXANDER - Hamfest. Genesee Radio Amateurs, 716-343-2844. Email: wa2abq@localnet.com

JULY 21

IL - SUGAR GROVE - Hamfest. Fox River Radio League, 815-786-2860. Email: w9ceo@arrl.net Web: www.frrl.org/
MA - CAMBRIDGE - Hamfest. MIT Radio Society/Harvard Wireless Club/MIT UHF Repeater Assn., email: w1gsl@mit.edu (617-253-3776 9am-5pm.) Web: http://web.mit.edu/w1mx/www/swapfest.html

ELECTRONIC MILITARY SURPLUS

FAIR RADIO SALES
WEBSITE: fairradio.com
E-MAIL: fairradio@fairradio.com
PHONE: 419-227-6573
FAX: 419-227-1313
2395 St. Johns RD - Box 1105 Lima, OH 45802
VISA, MASTERCARD, DISCOVER
We've Moved !!
Stop in on the way to the Dayton Hamfest.
Just off I-75 at Exit 122

2000 WATT SOLA REGULATOR

Sola CVS 2000 Watt Constant Voltage Transformer provides a very well regulated sinusoidal waveform that is isolated from variations and disturbances in the input voltage. Also provides isolation and step-up/step-down to allow for various input/output voltages. Input 95-130/175-235/190-260/380-520 60Hz. Output 120/240VAC 60Hz 2000VA. 17.8x11.4x9.6, 115 lbs sh. Unused, $250 ea, 2/$450

WHEATSTONE BRIDGE

ZM-4 Wheatstone Bridge used to measure DC resistance. Resistance measurement range 1 ohm to 1,011 M ohms +/-0.15%; As a resistance substitution box it is adjustable in 1 ohm steps from 0-10110 ohms. The current limit of the resistors is 16-500ma depending on setting. Galvanometer indicates balance in test circuit. Requires three "D" batteries. Also 22.5 to 200 VDC for more accurate readings above 1000 ohms. 5.8x7.3x8.8, 12 lbs sh. Used Reparable, $34.50 Used Checked, $49.50; Manual repro, $12.00

Allow money for shipping on merchandise.

SEND FOR OUR LATEST CATALOG !!

Radios - Test Equipment - Tubes - Antennas

Circle #35 on the Reader Service Card.

NEW **M.E.M. ELECTRONICS CO.**

Pocket Photo Advance (CJ-200)-1.3 Mega Pixel Camera & Voice Recorder
Unique, Pocket Sized, Digital Camera & Voice Recorder enables you to record a digital still picture, video and voice messages all in one unit! Record Voice in the meeting, when the right idea comes up or annotate your image or video

- 1.3M Pixel Image Sensor (1280 x 1024 or 640 x 480 resolution)
- 1.5 inch TFT, color, LCD Display plus optical viewfinder
- 3x Digital Zoom and manual focus
- 32Mbytes Flash Memory (Internal)
- Smart Media Card Slot (card not included)
- Number of Pictures: 250 pictures (1280 x 1024)
- Video Recording Time: 180 sec (320 x 240)
- Voice Recording Time: 4 hours
- USB (PC) & NTSC or PAL Video Outputs
- "Picture Station III" software (Win98, SE, 200, ME)
- Batteries: 4 x AAA
- Dimension (W x H x D): 49.8 x 120 x 25.5 mm - Weight: 98g

PLEASE CALL, WRITE OR E-MAIL: M.E.M. ELECTRONICS CO.
3119 BURN BRAE DRIVE DRESHER, PA. 19025 215-657-3119
E-mail: *memelectronics@erols.com* URL: www.memelectronics.com

Circle #33 on the Reader Service Card.

—AUTOTIME CORPORATION—

$79.00 + Parts

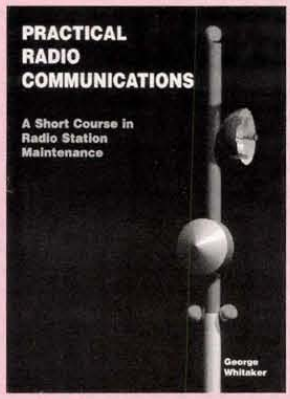
LCD Flat Screen Repairs Displays and Laptops

For Details
www.recycleLCD.com

Autotime Corporation (503) 452-8577
6605 SW Macadam, Portland, OR 97201

Circle #34 on the Reader Service Card.

Practical Radio Communications
Volumes 1 & 2



This is a short course for beginners that teaches you how to work on broadcast equipment.

Most books assume you are going to design the equipment and use theory at the molecular level. This course keeps theory to an absolute minimum. We don't want to design it, we just want to know how to fix it.

Starting with things as simple as "How to wire a mike plug," information is given in a logical, small dose learning pattern. Each section provides a building block for eventually getting an understanding of FM stereo and AM directional arrays.

George Whitaker, the author, says, "When I was growing up in this business, every book I could find was nothing but mathematical formulas for designing equipment, with a little bit of practical information buried in them. I decided to turn it around and write a book with a lot of practical information and a little bit of math behind it. I never saw the need for me to know how to design a diode, I just wanted to know how to check to see if it was good or bad. I couldn't find anything that would teach me troubleshooting procedure for a transmitter control ladder; that was what I needed to know. What I wanted was a book that said 'If you have these symptoms, first you ...' After 40+ years in the business, I wrote one."

$45.00 each Volume or Both Volumes for $80.00!!

Order through the Nuts & Volts Book Store today! Call our order only line at 1-800-783-4624 or check out the On-Line Book Store at www.nutsvolts.com

NEW! CREDIT CARD COMPUTER II

MVS PLUG-N-GO™ no cables/power supply to buy!
Low-power RISC cpu 10x faster than PIC. Z80. 8051
4m FLASH,ser,par,RTCC,4ch 12bit ADC,ISA104 bus
Built-in BASIC/Assembly, other compilers available
Friendly instructions, RS232 download (DOS/WIN)
Eval kit (1) $75, oem (1k) $21, CC computer I $14.20

$95 UNIVERSAL PROGRAMMER

Lowest cost, fastest, easiest to use! Do FLASH,NVRAM, EE,EPROM to 8m. Adapters for micros,plcc,etc. Optional gang banger for up to 10 ICs. Parallel port version available for notebooks. UV eraser $95

SINGLE CHIP COMPUTER

ZERO external components!
Built-in BASIC / Assembly
RS232 program download
1K flash, 64ee, 3irq, 2timers
15 i/o bits, ADC, 20pin DIP
20mips, faster than PIC/z80

oem(1k): $1.99 eval kit(1): $7.00

NEW! 8K SUPER CHIP
40x the BASIC pgm space
32 i/o, 12irq, 3timers, bus
8K flash, 512ee, 512nvram
watchdog w/internal timer
40 pin DIP part #MV8515
eval(1) $25, oem(1k) $7.10

SERIAL MINI-TERMINAL

RS232 terminal for Stamp, PC, Z80, AVR etc.
-super low current, powers from serial line
-LED backlit LCD, visible in all conditions
-115.2kbps, DB9 conn, simple commands
-specify 20 customizable or 16 tactile keys
eval(1) $75,oem(1k) $21,30,w/BASIC cpu $27

$27 MINI-PC

Includes DOS, ADC, 2par, 3ser, ISA bus,keypad/LCD interface. Complete! not a "core/engine" All utilities & tutorial included. Use TurboC,BASIC,MASM etc. eval kit (1) $95, oem (1k) $27
386 version eval $195, oem $55

STAMP DRIVE !!

Read/Write PC compatible hard disk, PCMCIA, Compact Flash. RS232 to ATA adapter for Stamp, Z80,8051,AVR,PIC,x86. ANY cpu
- 4 gigabyte capacity
- low power (5ma @5v)
- baud 115.2k and above
eval $95,oem $27,IDE ver. $14.20

WWW.STAR.NET/PEOPLE/~MVS

MVS Box 803
Nash.,NH 03060
(508) 792 9507

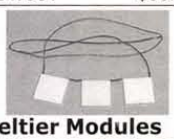
.MVS

5yr Limited Warranty
Free Shipping
Mon-Fri 10-6 EST

SERVING THE EMBEDDED COMMUNITY SINCE 1979!

Circle #36 on the Reader Service Card.

100 Ft RG8/U CABLE WITH N CONNECTORS
Foam core.
20W001 $39.95



Peltier Modules
3 units connected in series 1.18" (30mm) 254 junctions .6mm long .8mm max current 2A max Volts 30V (per module) 90 volts for the set of 3. 2 sets in series with the appropriate FWB rectifier and filter caps could be operated directly for 120V AC power. Modules may be separated and used individually.
21U002 $74.95

More Steppers on Web

Vextra Stepping Motor
Bipolar (4-wire) 5.6V .85A 1.8°/step 200 step/revolution Size 1-5/8" square X 1-1/2" long. 3/16" x 11/16" shaft (shaft has 2 horizontal 3/32" holes for pins)
21M001 $7.95 each

TWIST LOCK FEMALE CONNECTOR
NEMA L5-20 size, for 125V @ 20A.
98J020 $3.25 each

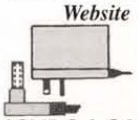
LM3909 IC
$5.99 each

Stepper Motor Semi Kit
This kit contains a UCN5804 unipolar stepper motor driver IC; a 42mm dia. by 22mm thick stepper motor 20M015, with shaft 3mm diameter x 12mm long and 13-tooth gear approx 16.6mm diameter x 5mm thick. 7.5°/step, 48s/rev., 12VDC, 50 Ohms, 6-wire; and all necessary documentation to make the stepper motor circuit.
93I003 $7.95/set

BIPOLAR STEPPER MOTOR DRIVER IC
600mA output current capability per channel. 1.2A peak output current (non-repetitive) per channel. 36V max. Enable facility. Temperature protection. Logical "0" input voltage up to 1.5V (high noise immunity). Internal clamp diodes. With documentation.
L293D $3.00 each

AC Voltage Tester
Non-contact Test, Voltage Sensitivity: 100 ~ 240 VAC, Frequency: 50/60Hz, Detection distance: <5mm, Over Voltage: 600V, Operating Temperature: 0 ~ 50C, Storage Temperature: -20 ~ 60C, Humidity: <85%HR, Battery: 2AAA, Dimension: 148 X 20 X 25mm, Weight: 40g, Safety: For indoor use only and in accordance with over voltage.
AC110VD $6.99

Wallwarts Galore on Website



13VDC 1.2A WHITE WALLWART
Class 2 transformer. Input: 120VAC 60Hz 25.5W through 3-prong grounded plug. Output: 13VDC @ 1.2A, 2.5mm x 5.5mm coax connector, center negative. 3.25" x 2.5" x 3.125".
20E018 $7.95 each

alltronics.com

VISA MasterCard

Mail Orders: PO BOX 730 - Morgan Hill, CA 95038-0730
Phone: (408) 847-0033 Fax: (408) 847-0133
Download our Catalog: http://www.alltronics.com

Dealers welcome by appointment. Visa, M/C, AmEx Accepted. All Sales Final. California Residents Add Sales Tax. Shipping Additional on All Orders. Prices Good 60 Days from Date of Publication and Subject to Change Without Notice.

Circle #37 on the Reader Service Card.

Events Calendar

MO - WASHINGTON - Hamfest. Zero Beaters ARC, 636-629-7368 (days) Email: n0mfd@arrl.net

JULY 26-27

FL - MILTON - Hamfest. Milton ARC, 850-994-7335. Email: wa4tfr@worldnet.att.net Web: http://home.att.net/~k4ozl/marc.htm

JULY 26-27-28

AZ - FLAGSTAFF - Convention. Amateur Radio Council of AZ, 602-881-2722. Web: www.arca-az.org/arca

JULY 27

NC - WAYNESVILLE - Hamfest. Western Carolina ARS, 828-236-0181. Email: wa4ola@arrl.net http://wcars.org/hamfest/index.htm

NY - FRANKFORT - Hamfest. Utica ARC, 315-797-6614. Email: ktrnd@borg.com

OH - CINCINNATI - Hamfest. OH-KY-IN ARS, 859-657-6161. Email: wd8jaw@arrl.net Web: http://www.ohkyin.org

JULY 28

MD - TIMONIUM - Hamfest. BRATS, 410-828-1605. Email: bbennett@ketron.com Web: www.bratsatv.org

AUGUST 2002

AUGUST 2-3-4

OR - PORTLAND - Convention. Willamette Valley DX Club, 360-256-7437. Email: k7ar@arrl.net Web: www.wvdxc.org

AUGUST 3

NY - ITHACA - Hamfest. Tompkins County ARC, 607-257-6066. Email: jdreid@lightlink.com Web: www2.compcenter.com/~tcarc/

OH - COLUMBUS - Hamfest. Voice of Aladdin ARC, 614-846-7790. Email: kb8kpj@cs.com

AUGUST 3-4

KY - LEXINGTON - Convention. National Guard Armory. Bluegrass ARS, Inc., 859-253-1178. Email: jrbarnes@iglou.com

DUSTMEISTER

Hunting the Elusive Dust Bunny — Part 2

By Robert Lang and Thomas Ober

In DUSTMEISTER Part 1, the hardware necessary to build an automated dust collector controller for a woodworking shop or for controlling any large electric motor was presented. In Part 2, building of a tool sensor from scratch and the programming and testing of the DUSTMEISTER will be covered.

The inconvenience of manual dust collector controls may lead the woodworker into not using the dust collector and thereby not getting the improved safety or air quality benefits. On the other hand, continuously running a dust collector leads to a distracting, noisy shop and the wasting of electricity and air conditioning. With the DUSTMEISTER, the shop-wide vacuum/dust collector system turns on whenever a woodworking tool is turned on and shuts off after the tool is turned off.

PROGRAMMING THE DUSTMEISTER

The PIC16F877 microprocessor is the brain that gives the DUSTMEISTER its intelligence. The microprocessor must be programmed before the vacuum controller will perform its function. Unlike your home computer, the PIC16F877 microprocessor does not forget its program when power is turned off.

Initially the software did not use interrupts, but this led to an unacceptable delay time from the time a tool was turned on or off before the DUSTMEISTER realized it. Since it was necessary to use interrupts, the programming was done in PICMICRO assembly language. The MICROCHIP MPLAB Integrated Development Environment which includes the assembly language is available for free at Source 1.

The assembled and linked code is available as DUSTMSTR.HEX at Source 2. After downloading the program, the program must be loaded into the PIC16F877. A simple circuit from Source 3 is shown in Figure 1 and can be connected to the PC's parallel port for programming the PIC. Several articles on the PIC programming process are found in Source 4. If you do not want to go to the trouble of programming the PIC16F877 chip yourself, preprogrammed chips are available from

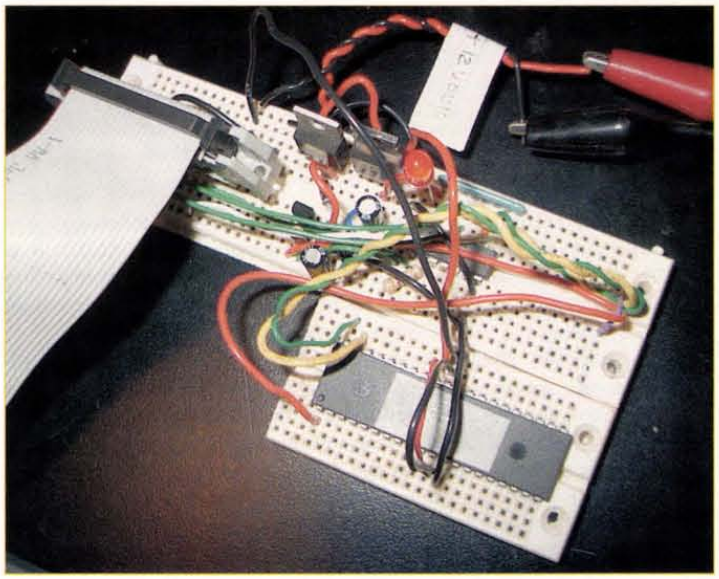


Figure 1. Morgan State Programmer Showing Parallel Port Cable Connection and PIC16F877

Figure 2. DUSTMEISTER Interrupt Source Code

```
;***********************************************
;**********INTERRUPT SERVICE ROUTINE **********
;***********************************************
; SAVE IMPORTANT REGISTER DATA
INTERRUPT   MOVWF    TEMP_W    ; SAVE W CONTENTS
    SWAPF   STATUS,W  ; SAVE STATUS WITH SWAPF TO
                ;PREVENT CHANGING STATUS REGISTER
    MOVWF   TEMP_S    ; SAVE STATUS (SWAPPED)
    MOVF    FSR,W     ; STATUS REGISTER IS SAVED SO NO NEED
    TO USE SWAPF
    MOVWF   TEMP_FSR  ; SAVE FSR INDEX REGISTER
    BANK0 ; MAKE SURE WE'RE USING BANK0

; IS THIS A REAL TIME CLOCK INTERRUPT?
    BTFSC   INTCON,T0IF  ; IS THIS A TIMER0 INTERRUPT?
    GOTO RTC_INTERRUPT
    GOTO POP  ; OTHERWISE EXIT INTERRUPT ROUTINE
; IS IT A RTC INTERRUPT
RTC_INTERRUPT   DECFSZ INTERRUPT_COUNTER,F
            GOTO POP
            MOVLW 15 ; ONLY PROCESS EVERY FIFTEENTH INTERRUPT
            MOVWF INTERRUPT_COUNTER
            CALL INIT_AD   ; INITIALIZE DATA AND SAMPLE CHANNEL
    0 = SENSOR1_V
            CALL CONVERT_ANALOG ; GET OTHER 2 CHANNELS =
    SENSOR2_V, SENSITIVITY_V
; RESET ALL TOOL ON FLAGS TO OFF
SETOFF1         BCF FLAGS,SENSOR1
            BCF FLAGS,SENSOR2
            COMPARE_NUMBERS SENSOR1_V, SENSITIVITY_V ; CHECK
    SENSOR1 AGAINST LIMIT
            BTFSS FLAGS,VALUE_LT_LIMIT
            BSF   FLAGS,SENSOR1 ; SENSOR1 VALUE IS > SENSITIVITY
            COMPARE_NUMBERS SENSOR2_V, SENSITIVITY_V ; CHECK
    SENSOR2 AGAINST LIMIT
            BTFSS FLAGS,VALUE_LT_LIMIT
            BSF   FLAGS,SENSOR2 ; SENSOR2 VALUE IS > SENSITIVITY
; TURN ON RELAYS IF FLAGS SET
            BTFSC FLAGS,SENSOR1  ; IF SENSOR1 FLAG IS SET THEN
    PREPARE TO TURN ON
            GOTO TOOLON         ; DUST COLLECTOR
            BTFSC  FLAGS,SENSOR2 ; IF SENSOR2 FLAG IS SET THEN
    PREPARE TO TURN ON
            GOTO TOOLON         ; DUST COLLECTOR
            BTFSC PORTE,M_SWITCH ; IF MANUAL SWITCH IN ON THEN
    PREPARE TO TURN ON
            GOTO TOOLON         ; DUST COLLECTOR
            BTFSC SYSTEM,VACUUM_STATE ; IF NO TOOLS OR MANUAL
    SWITCH ARE ON AND
            CALL TURN_OFF  ; DUST COLLECTOR IS ON, THEN PREPARE
    TO TURN OFF
            GOTO POP
TOOLON          BTFSS SYSTEM, VACUUM_STATE ; IF DUST COLLECTOR IS
    OFF AND
                            ;TOOLS/SWITCH ARE ON
            CALL TURN_ON        ; THEN PROCEED TO TURN ON DUST
    COLLECTOR
                        ; RETURN REGISTERS
POP           CALL SET_TIMER    ; RESET TIMER0
            BCF INTCON,T0IF ; CLEAR TIMER0 INTERRUPT FLAG
            MOVF    TEMP_FSR, W  ; MOVE SAVED FSR REGISTER TO W
            MOVWF   FSR          ; RESTORE FSR REGISTER
            SWAPF   TEMP_S, W    ; SWAP STORED STATUS REGISTER TO W
            MOVWF   STATUS       ; RESTORE STATUS REGISTER
            SWAPF   TEMP_W, F ;USE SWAPF INSTEAD OF MOVF SO Z BIT
    STATUS
            SWAPF   TEMP_W, W    ; WILL NOT BE CORRUPTED.
            RETFIE
; END OF INTERRUPT SERVICE ROUTINE
```

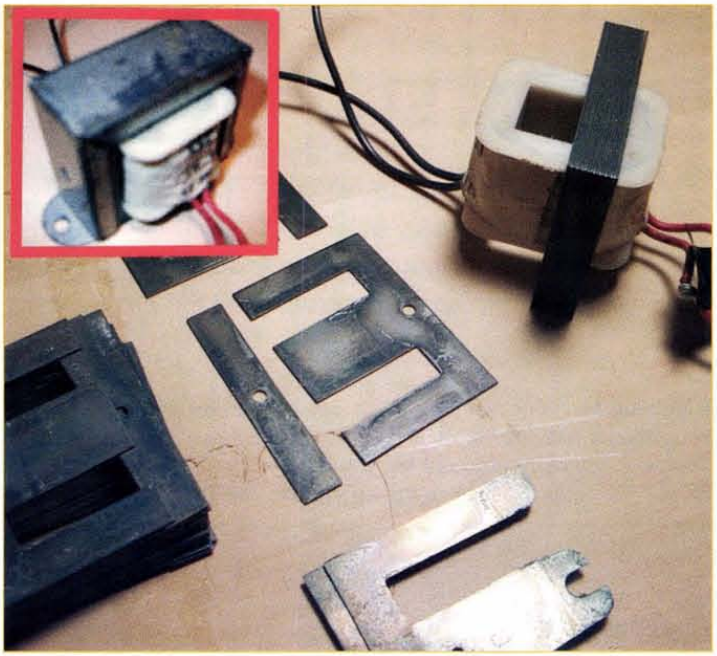


Figure 3. Transformer With Band and Laminates Partially Removed

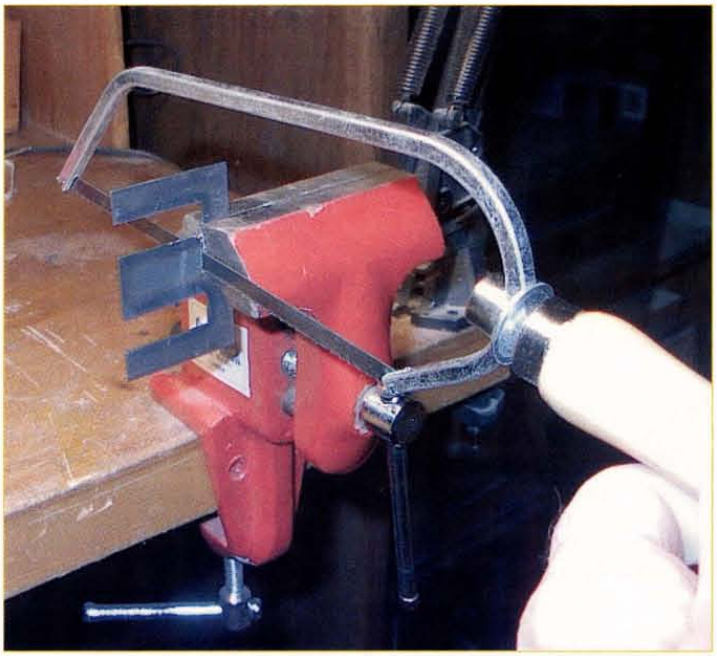


Figure 4. Converting E Laminate Pieces to C

Source 2. The program on the microprocessor does the following:

When powered up, the LCD displays a message "DUSTMEISTER 1. READY" to indicate that the DUSTMEISTER is working properly. The background task reads switch S2 to determine the number of seconds to delay and displays the messages shown in Table 1.

Approximately 10 times a second the background task is interrupted and the microprocessor jumps to the interrupt routine. Figure 2 is the source coding for the interrupt routine. The interrupt routines save important processor state information and read the current sensors and the current sensitivity limit from the A/D converter on pins RA0, RA1, and RA2. The interrupt routine also checks the status of the TEST switch S1. The software next compares each current sensor value to the current sensitivity limit. If the sensor voltage is greater than the limit, then the DUSTMEISTER knows that a tool is on.

If one or more tools are on and the vacuum system is off, then the TOOL_ON subroutine displays a countdown in the LCD and activates the ON relay for one second. The DUSTMEISTER remembers that the vacuum is now running. If the vacuum system was already running, then nothing is done.

If all the tools are off and the vacuum is on, then the TOOL_OFF subroutine displays a countdown in the LCD. When the countdown reaches zero, the TOOL_OFF subroutine checks the current sensors again. If all tools are still off, then TOOL_OFF activates the OFF relay for two seconds to turn off the vacuum system. The DUSTMEISTER remembers that the vacuum is now off.

If a tool has been turned on before the countdown reaches zero, then TOOL_OFF displays the message "SHUTDOWN ABORTED!" in the LCD and does not turn off the vacuum system. This feature avoids cycling the dust collector needlessly when one tool is turned off and another in turned on a few seconds later.

Finally, the interrupt routine resets the interrupt timer and restores the important processor state information that was saved at the beginning of the interrupt routine. The microprocessor returns to its background task of displaying the messages in Table 1 at the rate of one message per second.

ROLLING YOUR OWN TOOL SENSOR

For the more adventurous type, you may want to build your own tool sensor from scratch. If you want to build your own tool sensor, all you need is a scrap step-down transformer and some patience. Begin with a transformer as shown in the insert to Figure 3. Remove the binding strap

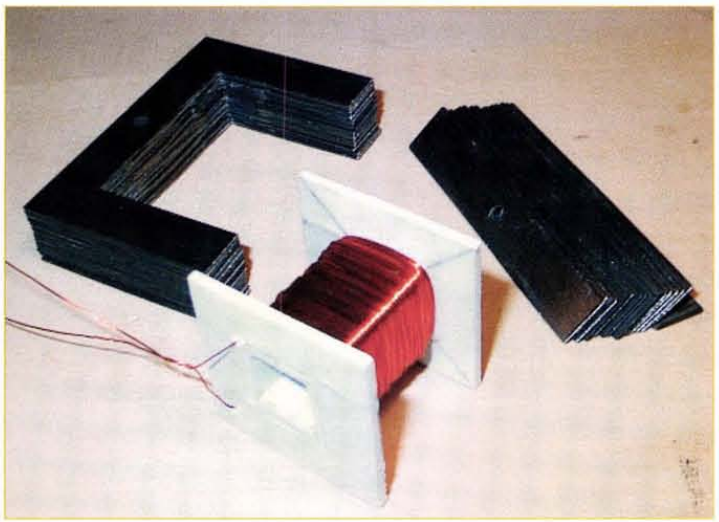


Figure 5. Wound Coil and C and I Pieces of Core

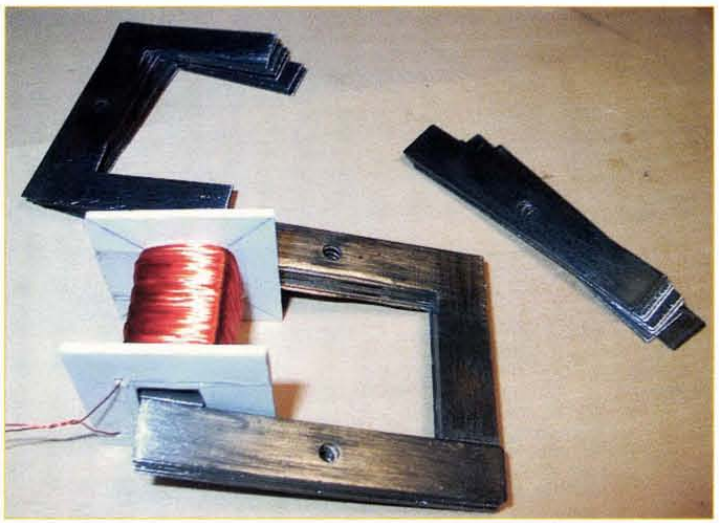


Figure 6. Assembling the Core

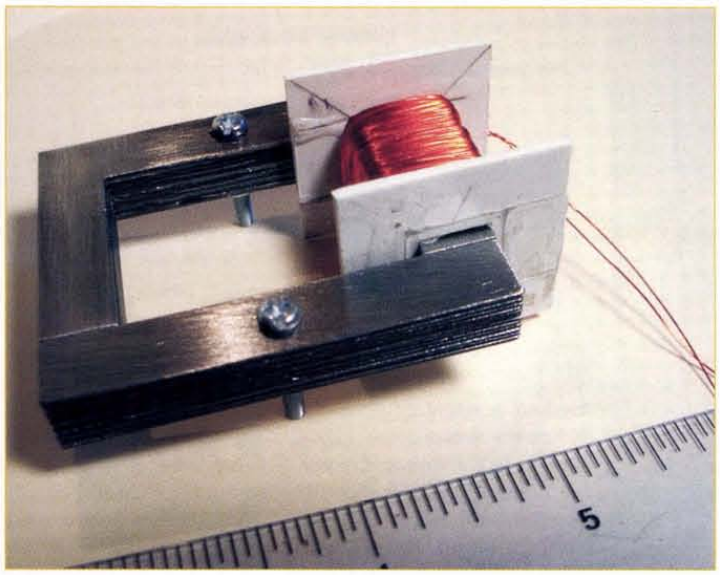


Figure 7. Finished Current Sensor

Figure 8. Sensor Calibration Set-up

and the first laminate from each side as shown in Figure 3. Do not be discouraged since these are the hardest to remove. The remaining laminates can be removed one at a time by popping them off with a chisel and hammer. Each interior laminate layer is made up of two pieces: one shaped like an "I" and one shaped like an "E." Each layer reverses the orientation of the "I" and "E" pieces. Using a hacksaw as shown in Figure 4, convert the "E" pieces to "C" pieces.

I had hoped to be able to reuse the transformer coil, but because the ends of the "E" pieces were not as large as the middle of the "E" piece, a new coil was required. Because the ends of the "E" pieces were 1 cm across, I decided to wind a 1 cm square coil. Since each laminate piece was .064 cm thick, the 1 cm core was formed from 15 pieces. I built a bobbin out of pieces of plastic. The question is what size wire and how many turns to put on the coil?

The wire on the secondary of the transformer that I took apart was 0.008 inch diameter. This would probably work, but since I was hand winding the coil, I went for a little larger 0.01 inch diameter #30 magnet wire.

About 100 feet of #30 wire was wound on the bobbin as shown in Figure 5 to give about 600 turns. I reassembled the core by alternating the laminated "C" and "I" pieces around the coil as shown in Figure 6. The completed unit was held together by using two small nuts and bolts as shown in Figure 7. If the transformer you disassembled did not have convenient holes pre-punched, you may want to use epoxy to re-assemble the core. I tested

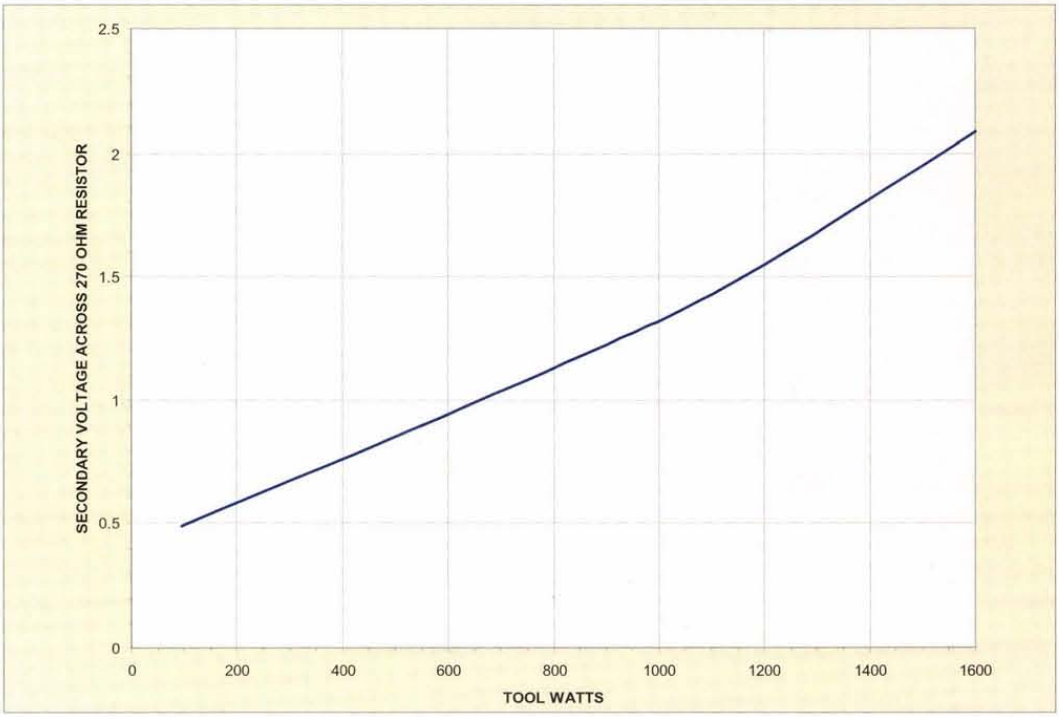


Figure 9. Sensor Calibration Graph

The first 7 messages are cycled continuously at a frequency of one message every second. Message 8 is displayed when there is a countdown in progress for starting or stopping the vacuum system. Message 9 is displayed if the vacuum shutdown countdown is stopped due to another tool being turned on.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*COMMENTS*
1					L	A	N	G		&		O	B	E	R						
2	D	U	S	T	M	E	I	S	T	E	R		1	.		R	E	A	D	Y	
3	O	N		D	E	L	A	Y		=		x		S	E	C	O	N	D	S	
4	S	E	N	S	O	R		#	x		=		x	x	x						Sensors 1 and 2
5	M	A	N	U	A	L		S	W	I	T	C	H		O	F	F				Also ON
6	O	N		S	E	N	S	I	T	I	V	I	T	Y		=		x	x	x	
7	V	A	C	U	U	M		O	F	F											Also ON
8	C	O	U	N	T	D	O	W	N		9	8	7	6	5	4	3	2	1	0	
9	S	H	U	T	D	O	W	N		A	B	O	R	T	E	D	!				

Table 1. DUSTMEISTER LCD Messages

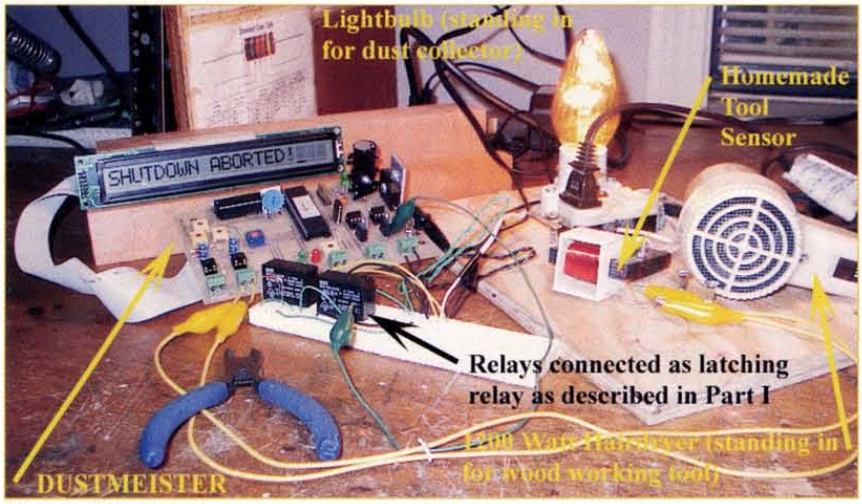


Figure 10. Final Testing of DUSTMEISTER Before Installing in Woodshop

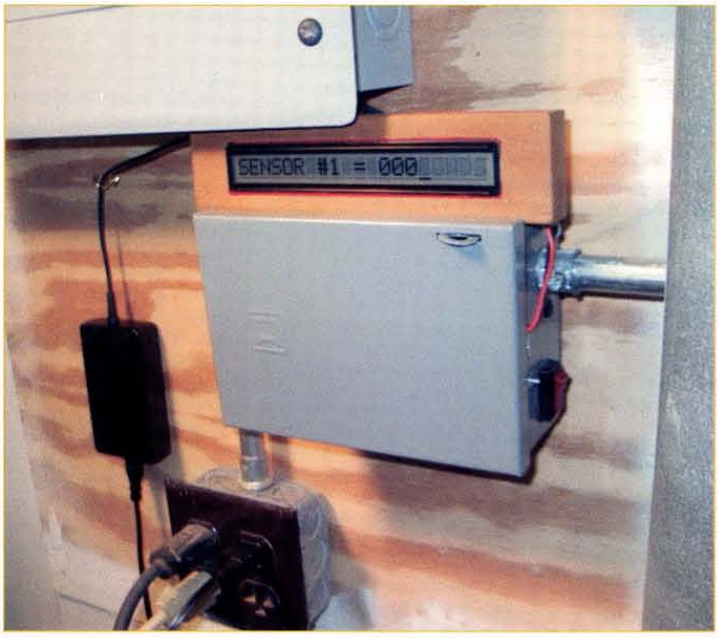


Figure 11. Completed DUSTMEISTER Unit (Access Door Closed)

the sensor with several different tool loads as shown in Figure 8 with several hair dryers standing in for tools. The results are in Figure 9.

If the wire carrying the tool current is looped about the core one or more times rather than just passing though the opening, the output voltage across the 270 resistor will increase.

TESTING AND CALIBRATING THE DUSTMEISTER

Before powering up the DUSTMEISTER, check the circuit board for any copper bridges. With IC1, OK1, OK2, and the LCD connecting cable removed, power up the unit and check the 5-volt and ground connections on the IC1, OK1, OK2, and LCD connecting cable sockets. Also check the ~+12 volt DC power.

If the voltages are correct, power down the unit and install OK1 and OK2. Apply five volts to terminal 2 of OK1 and 12 volts should appear at the "ON" relay screw terminals and the green "ON" LED should light. Repeat the process with pin 2 of OK2 and 12 volts should appear at the "OFF" relay screw terminals and the red "OFF" LED should light. Next, check the voltages at the output of the BCD switch, S2. Remember, the output of this switch is the compliment, so setting the switch to 0 should cause all four outputs to be high. Also, when testing the switch, note that the four horizontal traces on the top of the board near the switch are in the order 1,8,4,2 from top to bottom. Finally, shut down the unit and install IC1 and the LCD display.

Begin the testing and calibration of the DUSTMEISTER by setting the sensitivity control, R25, and the sensor gain controls, R5 and R8, to mid range. When the DUSTMEISTER is powered up, the display will cycle through the messages shown in Table 1. Adjust R10 (the LCD contrast) and R9 (the LCD brightness) for the best LCD display. The ON/OFF delay is controlled by setting switch S2 from 0 to 9 seconds. Two times the start delay time is used when turning the vacuum system off after the last tool is turned off.

If a sensor reading is greater than the SENSITIVITY reading controlled by R25, then the vacuum system will be turned on after the display counts down from the delay value. If all the sensor readings are less than the SENSITIVITY, then the vacuum system will be turned off after the display counts down from the delay value. The display sequence continues while the DUSTMEISTER is powered up. The display sequence requires between 60 and 800 mAmp at 12 volts AC depending on the setting of the LCD brightness control.

You are now ready to connect the DUSTMEISTER to the relays. Two wires connect from the ON relay terminal on the DUSTMEISTER to the coil of the normally open relay. Likewise, two wires connect from the OFF terminal relay terminal on the DUSTMEISTER to the coil of the normally closed relay. The ON relay normally open terminals are connected in parallel to the momentary contact manual ON switch on the motor controller. The OFF relay normally closed terminals are connected in series with the momentary contact manual OFF switch on the motor controller. If you are not using a motor controller, the DUSTMEISTER relays should be wired in a latching configuration as described in Part I. Figure 10 shows the final testing set-up using a latched relay set-up before moving into the woodshop for final installation.

In the workshop, the current sensors are connected to the current sensor terminals on the DUSTMEISTER. Up to two current sensors can be used. Each current sensor can handle several tools. The last connection is the DUSTMEISTER test switch that is just a normally open switch that can be used to test the DUSTMEISTER.

Turn on the manual switch and the ON relay should close for one second after the countdown is done. The green LED will confirm this. The manual switch should be turned off and the OFF countdown will begin. The off coundown is 1/2 as fast as the ON countdown. When 0 is reached, the OFF relay should open for two seconds which is confirmed by the red LED.

Now turn on all tools that have a power lead going through current sensor #1. As the messages are displayed, the reading for current sensor #1 should be non zero. If it is at the maximum (255), reduce the 20k ohm gain control, R8, for sensor #1, until a desired reading is accomplished. In my case, I was running a planer, bandsaw, and shaper through sensor #1 and adjusted R8 until I had a reading of 220 for sensor #1. If the ON relay turns on after the countdown, this is fine. Repeat the process with sensor #2. Do not change R5 and R8 gain settings from here on. Now turn on only the tool that uses the least current that has a power lead going through current sensor #1. In my case, it was

SOURCES

Source 1 Microchip MPLAB Integrated Development Environment including Assembler at http://www.microchip.com/

Source 2 DUSTMEISTER Homepage for preprogrammed PIC16F877 chips and circuit boards at www2.netdoor.com/~rlang

Source 3 Morgan State Programmer from P. H. Anderson at www.phanderson.com.

Source 4 Article on PIC programming in November 2001 *Nuts & Volts* by R. B. Lang

the bandsaw which gave a sensor #1 reading of 27.

When the tool is turned on, there is a current surge and then the sensor reading settles down to a steady state reading. All settings are based on this steady state reading, otherwise it is possible to set the sensitivity so that the dust collector will turn on based on the surge current and immediately turn off when the steady state current is reached.

If the ON relay turns on, this is fine. If it does not, then adjust the sensitivity control, R25, down until the ON relay turns on the dust collector and does not turn off when the steady state current is reached. In my case, I set the sensitivity control to 15. Repeat the process for the minimum current tool on sensor #2 if you are using a second sensor. Now your DUSTMEISTER is calibrated and will turn the vacuum/dust collector system on whenever any of your sensed tools are turned on and will keep the dust collector on when the tools are operating at minimum current.

FUTURE EXPANDABILITY

During the design of the DUSTMEISTER, I had several ideas that I thought would make the DUSTMEISTER even more useful. While these ideas did not make it into this design, the hardware interface for future expansion is incorporated into this design. The expansion interface makes ground, +5 volts, +12 volts, PICMICRO digital I/O pins RE3 and RC0-7, and analog inputs pins, RA3 and RA5 available for future use.

One idea for future expansion is to incorporate workshop climate information into the DUSTMEISTER. Temperature and relative humidity are important in the storage of wood. Some of my wood is stored in the workshop and other wood is stored on the second floor. It would be really nice if the DUSTMEISTER could report the current temperature and relative humidity in these two locations. It would also be nice to have the maximum and minimum values of temperature and humidity.

On the Internet, I found the humidity iButton from Dallas semiconductor. This chip measures temperature and relative humidity and sends the values digitally to a microprocessor using a one-wire interface. This sounded ideal, unfortunately when I inquired about the humidity iButton evaluation kit, I was told they were no longer available and that the humidity iButton would not be available until mid-2002.

Another idea is to use the DUSTMEISTER to control a HEPA filter system in the workshop to remove ambient dust kicked up by sanders or hand sanding. HEPA is an acronym for "high efficiency particulate arresting." These air purifiers effectively remove 99.97% of all pollen, mold spores, animal hair and dander, dust mites, bacteria, smoke particles, and dust that pass though the air purifier. The idea is to use a modified smoke detector of the photoelectric or ionization type as input to the DUSTMEISTER which activates the air purifier based on the amount of dust in the air.

The DUSTMEISTER can be used outside the workshop. It can be used in a spray paint booth to start and stop ventilation whenever spray paint equipment is operating. You can probably think of other features you would like in your workshop. Remember that the PIC16F877 microprocessor can be re-programmed at any time to add more features.

MASTERING THE DUST COLLECTOR

Figure 11 show the completed "intelligent" vacuum controller installed in a protective metal box. The DUSTMEISTER controls a shop-wide dust collector system by sensing when woodworking tools are turned on or off. The system automatically starts and stops the vacuum system based on tools running. The system intelligently avoids cycling the dust collector system unnecessarily by keeping track of situations when one tool is turned off and another is turned on after a short time. The system keeps the woodworker informed of system status with simple, easy to understand English messages. The system is expandable, limited only by your own imagination. Finally, after these many years, I am no longer a servant to my dust collector, but my dust collector is an obedient servant to my woodworking tools. And as for dust bunnies, they don't hang around my workshop any more. **NV**

Electrical Circuit Theory and Technology is a fully comprehensive text for courses in electrical and electronic principles, circuit theory and electrical technology. The coverage takes students from the fundamentals of the subject, up to and including first degree level. Thus, this book is ideal for students studying engineering for the first time.

For ordering details, check out the Nuts & Volts Bookstore on-line at www.nutsvolts.com or call 1-800-783-4624.

DesignNotes.com
Your Design Resource on the Web

Improve Your Design Skills, Find Project Advice and More

*** NEW ***
Velleman's PCG10
PC Function Generator
0-1MHZ

$199.95

For complete specs, visit: www.designnotes.com

Visit Our Online Forum

On-Line Circuit Archive
Hundreds of Circuits.
Over 23 Different Topics

Designing for Dollars
1) Submit your favorite circuit or program
2) Each month the best design entry (Judged by your peers) wins $100
3) Monthly winners are eligible for the yearly $1200 Grand Prize!

NEXT GRAND PRIZE DRAWING IS OCT. 2002

Share What You Know and Learn What You Don't

Visit Us at
www.designnotes.com

Circle #32 on the Reader Service Card.

Electro Mavin
Great Buys - Great Products - Great Gadgets
Check Out Our Great WebSite at
http://mavin.com
For Computer Items, Hobbiest Projects, Microwave Goodies and Some of the Greatest Prices on the Web....
800-421-2442 or FAX 310-632-3557
E-Mail
john@mavin.com or sean@mavin.com

by Stanley York

Laser Insight

In last month's issue, we began to look at the pulsed laser. The pulsed laser was the first type to be demonstrated back in 1960, and back then, it was a Cr:Ruby laser. Not many other materials were thought possible to use as lasing mediums, and it wasn't certain that ruby would be as cooperative as it was. Cr:Ruby has a fairly high lasing threshold, and must be pumped quite hard to make it lase at all. The ruby laser is still in use today, and has found a niche in the medical industry, where its main uses are for cosmetic surgery; hair removal, tattoo removal, and birthmark or skin blemish removal being the most common uses. But there are many other types of pulsed lasers, and I will briefly describe a few of them in forthcoming issues.

This month though, I want to start to put together a simple pulsed gas laser that you can build from stuff you may have in your garage already. If you are like me, and never throw away anything even remotely (or potentially) useful, then you're likely to have everything you need. If you don't have some of the items required, I'm pretty sure you can either scrounge something, or else find another way to make this laser work. But before we go any further, a few words of warning are required.

DANGER! DANGER! DANGER!

The laser about to be described should not be constructed by anyone unfamiliar with safe, high voltage working procedures.

The laser to be described below is experimental and dangerous! There have been many designs similar to this, and most of them have reported some measure of success. But the laser does require some careful adjustments and a good deal of insight to make it work reliably, or even at all!

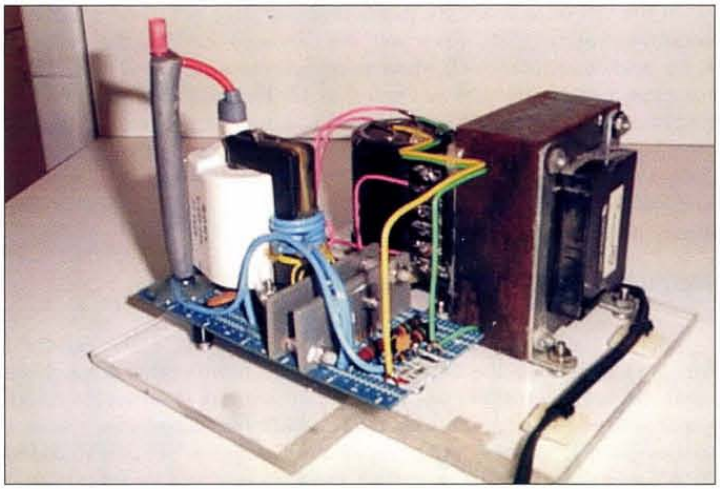
We will also be working with dangerously high voltages, so if you are not familiar with the precautions required when dealing with high voltages, then perhaps this article is not for you. The charged capacitor used to fire the laser can discharge in the pump chamber in about 5-6 nSec. If you calculate the peak power of the pulse, it is in the order of 100 megawatts or more, and it has a kick like two mules. Therefore, it will give you a very nasty shock if you are not careful. So if you decide to build this laser, PLEASE be very careful, and remember, if you show it to anyone, keep them away from the assembly altogether, especially your younger audience. YOU are supposed to know what you are doing and what parts you can safely touch. THEY do not.

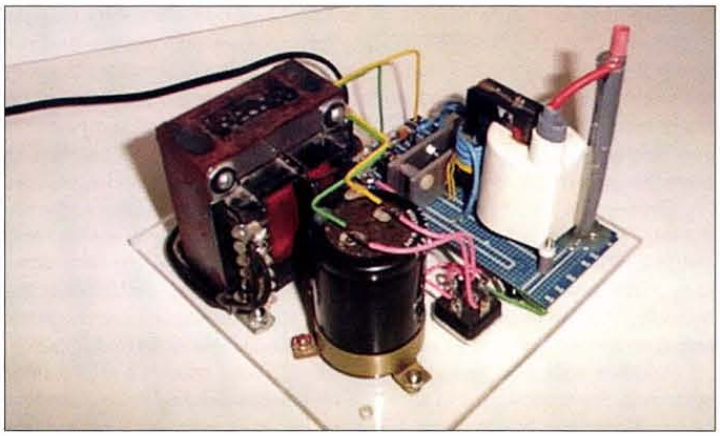
So again, if you are not comfortable yet with high voltage working procedures, then perhaps you should save this article until you get more experienced. The power supply is dangerous, and you will be working at your own risk, so be careful, this cannot be emphasized enough!! This is not a plaything, the charged capacitor is lethal!! Neither myself nor this magazine can be held responsible for any injuries! 'Nuff said, let's go on.

The power supply

Figure 11-1 shows the schematic for the high voltage power supply for this project. To drive the laser, we have to provide a high voltage to excite gas molecules at normal atmospheric pressure. A low voltage power supply consisting of T1, D1-D4, and C1 provides the high voltage inverter with approximately 9VDC at about 3A. I used a transformer with a center tap, so hat I could have two power levels for the laser.

When power is first applied, one of the transistors (say Q1) will conduct a little harder than the other, resulting in an inbalance in the circuit. The feedback winding is connected in the proper phase to reinforce the base current to that transistor. As the current in the windings increases, the drive voltage to that transistor base will also increase, turning the transistor hard on, while at the same time forcing Q2 off. The collector current will thus increase until the core





becomes saturated, and the flux in the magnetic circuit no longer increases. Thus, the spread of magnetic influence stops, the base drive reduces to the current delivered by R1 alone, and the magnetic field begins to collapse. The collapse induces a voltage in the reverse sense, and causes a drive signal to appear at the base of Q2, turning it on. The drive signal from the feedback winding is again correctly phased to reinforce the base drive current, forcing Q2 hard on and Q1 hard off. When the magnetic flux reaches saturation level, the magnetic field again collapses, and repeats the cycle as long as power is applied.

The same magnetic flux is also coupled to the high voltage winding of the transformer, where it induces a high voltage in this winding. Inside the transformer molding there is usually a high voltage rectifier, or sometimes a voltage doubler or tripler circuit, that rectifies the resultant high voltage. It is shown as D5 in the schematic for explanation only.

Flyback transformer modification

The DC voltage provided by the low voltage supply is passed to the inverter section where it is stepped up by the TV flyback transformer T2. If you have an old color TV or computer monitor, and you are sure the flyback is okay, you should be able to produce close to 20,000 volts with 9VDC input to the inverter. If your flyback has a bad winding on it, you'd better discard it and find another one, or you could have problems later on. Usually, the high voltage rectifier, shown as D5 in the drawing, is contained within the transformer molding, and is not required externally. It is only shown here for clarity. To make the power supply, begin by getting a length of #12-16 insulated

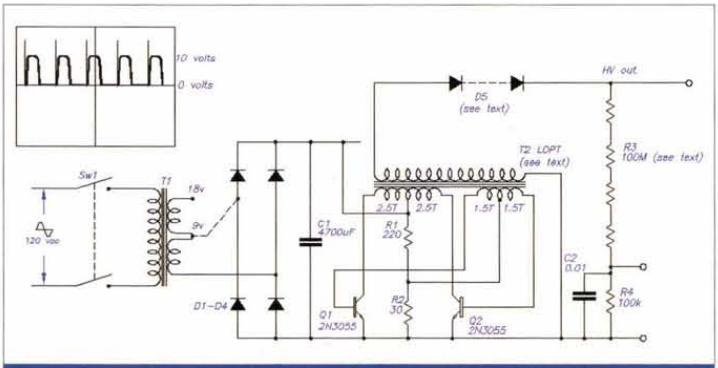


Figure 11-1. A simple power supply made from an old TV transformer is all that is needed to drive this laser. In spite of its simplicity, this supply can produce over 30,000 volts. So be careful with the HV wiring.

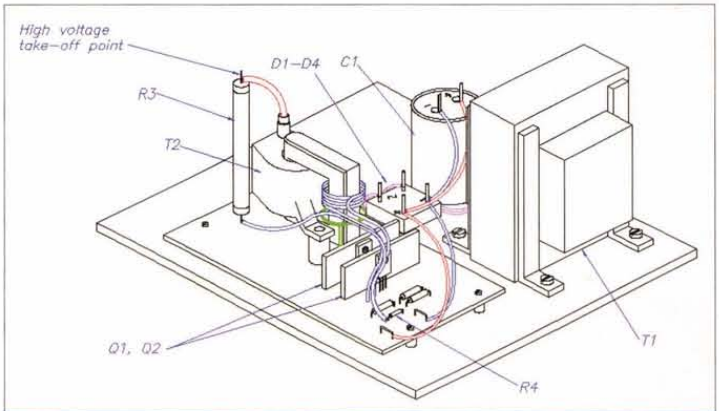


Figure 11-2. This drawing shows the final layout of the high voltage power supply used in this project. Remember to apply a generous coating of hot-melt glue or silicon sealer on all high voltage connection points.

flexible wire and wind about 8-10 turns around the exposed section of ferrite core of the flyback, and bring out a connection at the center tap. This will be the primary winding of the new transformer. Get a length of smaller flexible wire (#18-24) and wind on about 6-8 turns, again bringing out the center tap. This will be the feedback winding.

Construction of the circuit couldn't be much easier. Lay out the components for the high voltage section on a piece of perfboard, and use point-to-point wiring on the underside. Mount the transistors to heatsinks, because they will get warm, depending on how long you run the supply. I mounted my transistors on separate heatsinks to give maximum heat transfer. Leave the new primary winding wires, and the feedback wires a little long until correct operation has been established, and output voltage optimized. For convenience, mount the high voltage assembly, and the low voltage power supply on a common plate. This makes it easier to carry around. Component lay-out is not critical, and a suggested lay-out is shown in Figure 11-2.

Optimizing the power supply output

When you start the power supply, you will find that you will not be able to make accurate measurements of the high voltage output. There are not many multimeters or digital voltmeters — for home use anyway — that can measure much above 1000VDC, so we have to fool it somehow.

What I did on my system was to connect a 100 Mohm resistor, R3 (high voltage of course, about four inches long), to the output terminal, and connect a 100 Kohm resistor R4, in series with it, and terminate the 100K to the common line. The voltage at the junction of the two resistors would then be 1/1000th of the output voltage (ignoring the small loading effects of the DVM). With a small capacitor across the 100K to filter out the spiking, the voltage reading at this point is fairly representative of the output voltage of the supply. It is not perfectly accurate, but we only need a ball-park figure to find the highest output. You will also need to find the return side of the high voltage winding, and what I did was monitor the output voltage as suggested above, and use a couple of clip leads and a 1K resistor to jumper each vacant pin on the transformer to the negative side of the power supply (see below). You cannot use a DVM or ohmmeter to find the return line because of the presence of the high voltage diodes in the output circuit. The use of a 1K resistor between windings during this test prevents the oscillator from stalling if, for instance, you short-circuit across a winding. A 1K resistor in the high voltage has little effect.

When you finish building the supply, turn it on while monitoring the output across the 100K resistor, and jumping out the vacant pins on the transformer (always turn the power off between tests, otherwise you may be in for a nasty surprise). When you find the return pin, you should get something around 3-5 volts across R4, corresponding to 3-5 kilovolts output from the transformer (remember, the scale is 1000:1). Begin optimizing by removing one turn from

Parts list for the power supply

R1	220 1W
R2	30 1W
R3	100M high voltage resistor, or a chain of 10M high voltage resistors
R4	100K 1/2W
R5	100M high voltage resistor, or a chain of 10M high voltage resistors
C1	4700uF 35V
C2	0.01uF 50V
Q1, Q2	2N3055 or equivalent NPN power transistor, plus heatsinks
D1-D4	50PIV 3A diodes or equivalent bridge rectifier
T1	9-0-9 V/3A power transformer
T2	TV flyback transformer SONY 1-439-254-12 or equivalent
Sw1	DPST toggle switch

www.gatewayelex.com
(Electronically Speaking, Gateway's Got It!)
gateway ELECTRONICS, INC
MAIL ORDERS CALL TOLL-FREE 1-800-669-5810
Circle #87 on the Reader Service Card.

LASERS & ACCESSORIES
HELIUM NEON LASERS
Complete Systems
Plasma Tubes
Power Supplies
ACCESSORIES
Optics
Electro-Optics
IR Viewers
Books & More
DIODE LASERS
Visible / IR
Complete Modules
Collimating Optics
Drive Circuits
WEBSITE:
www.mi-lasers.com
MEREDITH INSTRUMENTS
Phone: 623-934-9387 • Fax: 623-934-9482
Circle #85 on the Reader Service Card.

each side of the primary winding. Don't cut the wire yet, until you see an improvement in output.

As the turns ratio increases, you will see a corresponding increase in output voltage. Removing turns from the feedback winding will also change the output, but not so dramatically as the primary windings. Let the supply run for about 30 seconds at a time until you feel comfortable with the operation. The transistors will run a little warm, which is normal. Finish optimizing the output by trying to get the highest voltage consistent with the lowest input current and lowest operating temperature for the transistors.

If you get to a point where you can see about 18K volts with 9VDC input, then this is about right. On my unit, I was getting close to 19K volts at 9.6 volts DC input. When it was run on 18 volts DC, I got over 33K volts! I didn't run it for long though because the transistors started to get hot. If you have an oscilloscope, monitor the transistor collectors. You should get a waveform similar to the one shown in the inset in Figure 11-1. The frequency was about 75KHz.

Again, I feel I must impress upon you the dangers of high voltage, especially when you start charging capacitors. During the optimization of my unit, I did receive a jolt from a series of small capacitors (0.001uF each) that I had strung across the R3. I was a little too hasty to make changes, and overlooked these small caps. I received an estimated 2-3 KV discharge into my left hand. It felt like a static shock that you get after walking across a synthetic fiber carpet and touching a doorknob on a cold, low humidity day. Not serious, but it sure makes you realize what you're dealing with. So please be careful. It's not so much the shock that hurts, but your reaction to it, and what may happen as a result of your reaction.

When you are satisfied with the working of the assembly, solder a banana socket to the top of the 100M resistor to act as a connection point. Cover the socket with heat-shrink sleeving. Tidy up the wiring on the reverse side of the power supply, bundle up and secure all cables with hot-melt glue. Finally, cover all the high voltage points with heat-shrink sleeving, cable insulation, and silicon sealer or hot melt glue to prevent you from accidentally touching any hot spots before they are discharged.

Until next time, you can amuse yourself by flattening a piece of copper wire, and making a small indent in the middle. With the indent face down, bend about 1/4" of the end of the wire at right angles to form an elongated Z. Solder a pin into a banana plug and place it in the socket on the high voltage supply. Carefully balance the wire on the pin and turn on the power supply. The piece of wire will start spinning at a very fast rate due to ion propulsion off the bent ends. If your balancing is not so good, the wire will go flying off the pin, so watch out in case it throws itself into your power supply!! **NV**

As always, if you have any questions or comments about this column, about optics, or lasers in general, or if you have ideas for projects, please contact me either through this magazine, or directly by email at: **stanley.york@att.net**

Use your PC as a scope and datalogger!

PC-based Instruments!

Parallel Port Scope
spectrum analyzer, and digital multimeter

ADC Virtual Instruments turn your PC or laptop into a sophisticated storage scope AND spectrum analyzer AND multimeter. Display simultaneously on large screen! 100MS/s 8-bit or 1.2MS/s 12-bit or 333kS/s versions. Great for schools, test depts, etc. Input to Excel! LabView/NT drivers included.

Environmental Logging
record temperature, humidity, etc.

ENVIROMON - temperature (thermistor), humidity & light sensors, door position, etc. Record for 365/24 without a PC even if power fails. Monitor 30 sensors 400 yds away. With cables and easy software. Remote audio alarm. Use **TC-08** for most thermocouples.

DRDAQ for PCs
sciencelogger with sensors

DRDAQ - is a PC adapter with sensors for light, pH, volts and temp. Great for science fairs! Supplied with ready-to-run software and lots of physics/chem exp'ts.

Download FREE demo software. Sales only: 1-888-7SAELIG
www.saelig.com 716-425-3753 • -3835 (fax) saelig@aol.com

pico Technology Limited ®

Stocked in NY by Saelig Company: *Virtual Instruments, I2C and embedded controllers, BITlink 2-wire networks, RS232/422/485, CANbus, etc. See* ***www.saelig.com*** *for Product of the Month!*

Circle #86 on the Reader Service Card.

ELECTRONIX EXPRESS

Visit Our Website At http://www.elexp.com

WELLER SOLDERING STATION – *MODEL WLC 100*
- Variable power control (5 to 40 watts)
- Replaceable heating element
- Quality light-weight pencil iron

$36.95

LOWEST PRICE 20MHZ
INSTEK OSCILLOSCOPE
MODEL GOS-620
Dual Channel – *20MHZ*
(INCLUDES PROBES) $299.00

SCOPE PROBE 60 MHZ *SWITCHABLE X1, X10* $12.95

DIGITAL MULTIMETER
32 Ranges – 3½ Digit
MODEL MY-64 $27.95
AC/DC Volt/Current, Res. Cap., Frequency. Rubber Holster Included

INSTEK® FUNCTION GEN. WITH INT/EXT FREQ. COUNTER
3 MHz, Digital Display
MODEL 8216 $199.00

ALLIGATOR LEADS *SET OF 10* $2.10

SWITCHES
Mini Toggle SPDT ..... 50¢ ea.

SOLDERING IRON 3-WIRE
HIGH PERFORMANCE
#060501 $5.25

PAD-234
DIGITAL/ANALOG TRAINER
Complete portable workstation. Variable and fixed power supplies, function generator, digital I/O, rugged design, high impact case.
Assembled $150.00 Kit $110.00

HIGH QUALITY TOOLS
With Cushion Grips and Return Spring
Needle Nose Pliers $2.95 | Wire Stripper $1.50 | Diagonal Cutter $2.95

DC POWER SUPPLIES
MODEL HY3003 – DIGITAL DISPLAY
Variable output, 0-30 VDC, 0-3 Amp $89.00
MODEL HY3003-3 – TRIPLE OUTPUT
Two 0-30 VDC, 0-3 Amp variable outputs plus 5V 3A fixed. Digital Display. $215.00

RSR——TELECOMMUNICATIONS TRAINER
HANDS-ON TELEPHONY, LAN, CATV EXPERIENCE WITH ONE SELF-CONTAINED UNIT
T-Comm Trainer (TCM-100) $199.95
Lab Manual / Work Book 26.95
Component and Supplies Kit 37.95
Tool Kit 119.95
Only $199.95
MODEL TCM-100

SOLDERLESS BREADBOARD
830 tie points. MB102PLT model features 3 binding posts and aluminum backplate.

Part No.	1-9	10+
MB102	5.95	5.00
MB102PLT	8.95	8.00

MOTION DETECTOR
$2 ea. – 10 For $15

PRESS-N-PEEL
PC Board Transfer Film
PNP Blue 5 Sheet $9.90
PNP Wet 5 Sheet 9.90
PNP Blue 20 Sheet .. 28.95
PNP Wet 20 Sheet ... 28.95

RESISTOR KIT
1/4 W 5% film. 5 pieces each of 73 values. 365 pieces total. $3.95

LM555 10 Min.	22¢ ea.
LM741 10 Min.	27¢ ea.
74LS00 10 Min.	18¢ ea.
7805 Regulator 10 Min.	30¢ ea.
2N3904 10 Min.	6¢ ea.
PN2222 10 Min.	6¢ ea.
Red LED T 1¾ 10 Min.	6¢ ea.
Green LED T 1¾ 10 Min.	7¢ ea.
Yellow LED T 1¾ 10 Min.	8¢ ea.
Photo Cell 10 Min.	65¢ ea.
100K Pot, 1" Shaft PC Mt. 10 Min.	15¢ ea.

FREE CATALOG
MORE Low-Priced Items In Our **FREE** *256-Page Catalog*

TERMS: Min. $20 + shipping. School Purchase Orders, VISA/ MC, Money Order, Prepaid. NO PERSONAL CHECKS, NO COD. NJ Residents: Add 6% Sales Tax.

In NJ: 732-381-8020
FAX: 732-381-1006
365 Blair Road • Avenel, NJ 07001-2293
800-972-2225
http://www.elexp.com
email: electron@elexp.com

Circle #84 on the Reader Service Card.

Build a 418 MHz Wireless Remote Control

By Anthony Caristi

UHF operation is superior over infrared since it is effective over much larger distances, and can pass through solid objects. The wireless remote control described in this project is an RF device, which operates at 418 MHz in the UHF band.

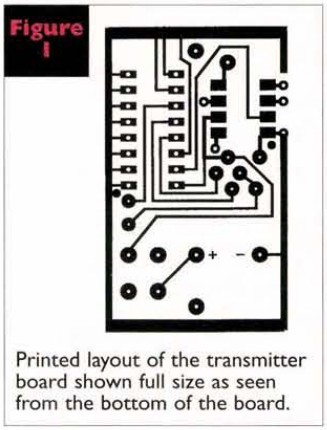
You have seen wireless remote controls everywhere: TV and VCR controls, wireless key entry on vehicles, some appliances such as air conditioners, and even your electric blanket. TV and home entertainment controls work by using an encoded beam of infrared light, while vehicular remote keyless entry operates on one of the unlicensed UHF bands provided for this service. UHF operation is superior over infrared since it is effective over much larger distances, and can pass through solid objects.

The wireless remote control described in this project is an RF device, which operates at 418 MHz in the UHF band. It meets FCC requirements for unlicensed devices since the transmitter (and receiver) module has already been given approval for this type of service. No RF expertise is required to construct this circuit. These low-cost RF modules are readily available from electronics parts distributors.

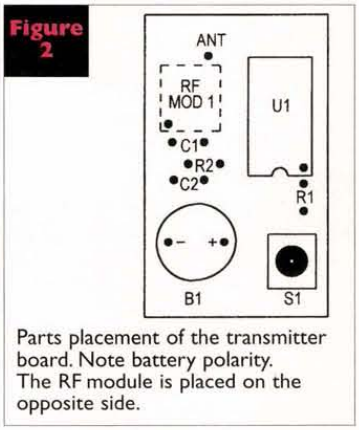
This project has been designed to illustrate one application of remote control: how you will be able to turn on and off any lights in or around your home as you arrive or leave during darkness. Any other application is easily implemented, since the receiver circuit employs an electromechanical relay with uncommitted contacts. The number of applications for this project is limited only by your imagination.

The transmitter is a tiny hand-held module, similar to that used for vehicular keyless entry. The receiver, powered by a wall transformer, is placed in the home (or any other location) where it will be able to control lights or any other electrically-operated device. The receiver may also be operated by a vehicular 12-volt DC power source or a portable battery. This feature opens up a multitude of uses for this remote control system.

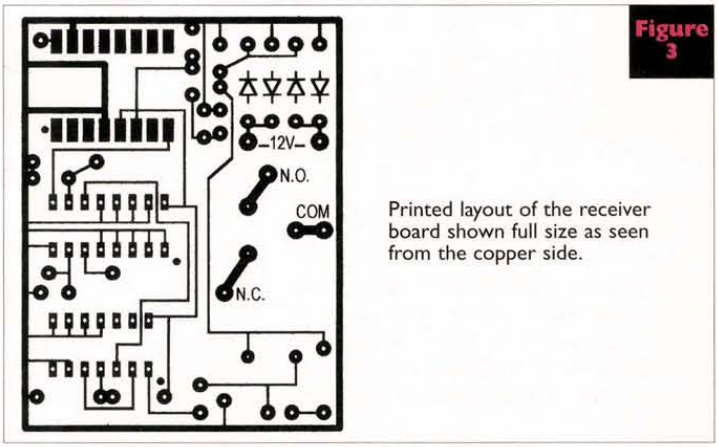
The transmitter and receiver are each encoded to the same nine-bit digital address. Using trinary data (0, 1, or open circuit), 19,683 different codes are possible. This virtually precludes anyone from being able to operate your system with an unauthorized transmitter.



Printed layout of the transmitter board shown full size as seen from the bottom of the board.



Parts placement of the transmitter board. Note battery polarity. The RF module is placed on the opposite side.



Printed layout of the receiver board shown full size as seen from the copper side.

ENCODING AND DECODING SYSTEM

A digitally-controlled remote control system is useful and reliable only when the modulated radio frequency carrier is encoded with a unique address that can be recognized by a receiver that is similarly encoded. This type of modulation — sometimes called on/off keying (OOK) or amplitude shift keying (ASK) — uses a high amplitude carrier level for 1s, and a low level for zeros. Encoding the transmission prevents unauthorized and spurious operation.

The encoder, U1, and decoder, U2, are each hard-wired for a unique address as selected by the builder. If more than one remote control system is desired, it is a simple matter to use different addresses for each. In this way, there would be no interference between systems. U1 contains nine address bits that can be wired to ground, Vdd, or left open. When the circuit operates, a U1 generates a positive-going pulse train that contains the address information. This is used to modulate the RF transmitter module.

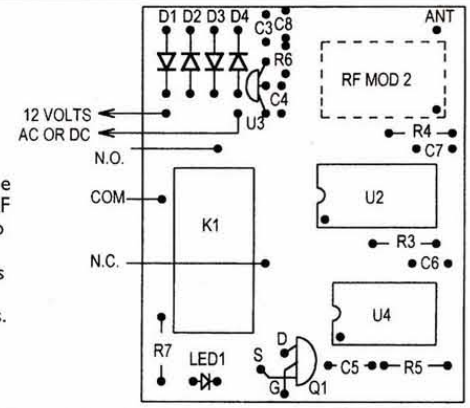
The decoder chip in the receiver, U2, also contains nine input terminals which are wired for the same address word as the transmitter. When the encoded pulse train is presented to the data input terminal of U2, the address is checked twice. If two successive transmitted pulse trains contain the correct address, the valid output terminal, pin 11, goes high and remains so as long as the transmitter is operating.

THE TRANSMITTER CIRCUIT

Refer to the schematic diagram for the transmitter. A single lithium coin cell, with a nominal voltage of 3.3 volts, powers the circuit through the transmit switch S1. Since the cell is called upon to deliver current for very short intervals whenever remote control operation is desired, battery life will be extremely long.

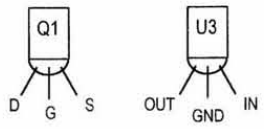
U1 is the digital encoder chip that provides the modulating pulse train. Pins number 1 through 7, plus 9 and 10, are the address input terminals A1 through A9. Although the printed circuit layout for the transmitter is designed with all address inputs connected to circuit common

Figure 4



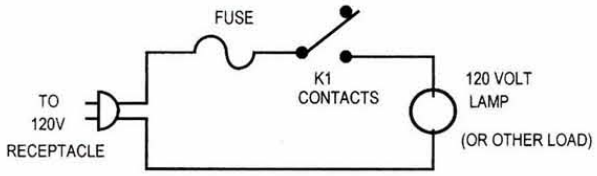
Parts placement of the receiver board. The RF module is soldered to the opposite side. Note the connections to the relay contacts and power input pads.

Figure 5



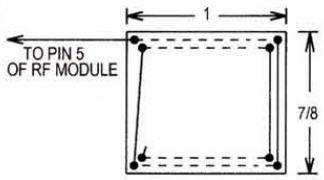
Terminal identification of Q1 and U3.

Figure 6



Typical lamp control circuit. CAUTION: This circuit utilizes high voltages. Be sure to use proper wire size and insulation.

Figure 7



Loop style antenna fits in compact space.

for an address of 000000000, the builder has the option of using any other of the 19,682 addresses available. This is accomplished by cutting the foil pattern to any or all address terminals, as desired. Then leave them open circuit or connect any or all to Vdd (pin 16). Remember, the corresponding receiver address input terminals must match those of the transmitter.

Timing components R1, R2, and C2 provide an encoded pulse train that has a pulse repetition frequency (PRF) of about 20 per second. When power is applied to the circuit, pin 15 of U1 drives the data input terminal of the RF module (pin 2), causing it to generate a train of 418 MHz pulses in accordance with the encoded address. The data pulse train continues to be generated as long as the power switch is held down. A typical transmission might take only one-half second, which allows several pulse trains to be generated.

The output of the RF module, pin 5, is connected to a short wire that acts as the antenna. The RF pulses are thus transmitted to any receiver which may be within the operating range of the system. This could be 300 feet or more, depending upon the antenna and line-of-sight transmission distance.

THE REMOTE CONTROL RECEIVER

Refer to the schematic diagram of the receiver. Since the receiver will most likely be located near the light (or other device) that is to be remotely controlled, a wall transformer is used to power the circuit. The AC output voltage of the transformer, about 12 volts, is fed to a full wave bridge that charges C3 up to about 16 volts DC. A linear regulator chip, U3, provides five volts to operate the circuit.

For vehicular or portable use, the receiver may be operated from the 12-volt DC power of the vehicle, or a separate battery. Current draw of the circuit is about 50 milliamperes, mostly for the relay coil.

A short wire antenna feeds the RF input of the receiver module, pin 16. The receiver circuit utilizes a single conversion superheterodyne design that incorporates a surface acoustic wave (SAW) resonator and ceramic filters for frequency accuracy and stability. The RF pulses are detected and appear at the data output terminal, pin 8. The recovered data, as sent by the transmitter, is fed to decoder U2 pin 9. This chip has nine address terminals, which must be wired exactly in accordance with the hardwired address of U1 in the transmitter.

Decoder U2 examines each pulse train individually. When two successive pulse trains contain the correct address, the valid data output terminal, pin 11, goes high. It remains so until the transmitter is turned off or an invalid transmission is received.

In order to accomplish two functions (ON and OFF) for the device under remote control, JK flip-flop U4 is utilized as a latch. The valid output data terminal of U2 feeds the clock input terminal of U4. Each time the transmit switch is pressed and released, the rising edge of the valid data pulse transfers the logic level of U4 pin 2 to pin 1. Thus, the first valid transmission will generate a logic level 1 at pin 1 of U4, and the next transmission will cause it to revert back to zero. In this way, the transmitter will toggle U4 pin 1 to the desired state.

The output terminal of U4 is fed to the gate of MOSFET transistor Q1. This, in turn, controls current through the coil of relay K1. The contacts of K1 are hardwired as desired to operate the device under control. In the circuit of Figure 6, a lamp control is illustrated.

In order to provide visual assurance that the receiver is operating in response to the transmitter, LED1 is connected across the relay coil and indicates when the relay is activated.

TRANSMITTER ASSEMBLY

Figure 1 illustrates the printed layout of the transmitter PC board, shown full size as seen from the bottom. The top of the board is solid copper, which acts as a ground plane. Round cut-outs must be manually cut into the copper to allow clearance between the ground plane and all non-grounded leads of the through-hole components. An etched and drilled board for both transmitter and receiver is available from the source indicated in the Parts List.

Before beginning assembly of the board, refer to the schematic diagram and use a small drill bit, such as 3/16 inch in diameter, to manually remove copper in a small circle around each hole in the ground plane that will contain a non-grounded wire lead. This is necessary so that such leads do not contact the ground plane, and short out. Be sure to clear any holes that might be used for address terminals of U1 that will be left open circuit, or connected to Vdd potential. When done, remove any burrs left over from the clearing operation.

The first component that should be mounted to the board is the RF transmitting module. This is a surface-mounted component that is soldered to the bottom of the board. Use the following procedure:

1. Gently clean the PC board using a steel wool pad. Be sure there are no contaminants, opens, or short circuits at or near the printed wiring. Rinse and dry the board thoroughly.

2. Locate pin 1 of the RF transmitting module, and that of the corresponding foil pad as indicated by a small dot.

3. Place the module in position, directly over and centered along the foil pattern.

4. Using a low-powered pointed soldering iron tip, carefully apply heat and solder between pin 1 of the module and the foil pad. Allow the melted solder to wick underneath the module, ensuring a good connection. CAUTION: Do not use too much heat or too much solder; to do so

may cause the foil to lift off the board or damage the RF module.

5. Examine the module to be sure that all terminals are in the proper position over the pads. If not, repeat step 4.

6. Solder the remaining terminals of the module as described in step 4.

7. Examine the assembly very carefully to be sure that all connections are solid, and there are no short circuits between adjacent foil pads.

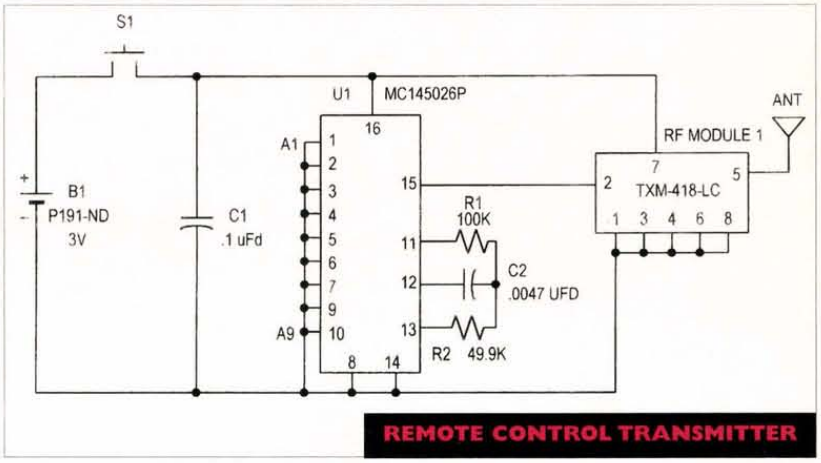
Once the RF module is soldered in place, pass thin solid wire through the holes adjacent to terminals 1, 3, 4, 6, and 8, and solder on both sides of the board to effectively connect these terminals to the ground plane. Cut any excess wire on both sides of the board.

All remaining thru-hole components (except the battery) may be inserted in the board and soldered in place as indicated in Figure 2. Be sure to observe the orientation of U1. An error here will result in an inoperative circuit and possible damage to the RF module and U1. The battery will be installed later, during check-out of the transmitter.

For the initial test of the transmitter, use a straight piece of solid wire 6-1/2 inches long. Solder it to the pad adjacent to pin 5 of the RF module, and orient the wire right angles to the ground plane of the PC board. A permanent antenna will be installed later, as described below in the section concerning transmitting and receiving antennas. When finished assembling and wiring the transmitter, check it carefully for any possible errors. It is easier to correct mistakes now rather than later on if you discover that your transmitter does not work.

A small enclosure may be used to house the printed circuit board after transmitter test. One such option is specified in the Parts List. A suitably-sized hole should be drilled in the top of the enclosure to allow the pushbutton to protrude.

Place the transmitter aside while working on the receiver.



REMOTE CONTROL TRANSMITTER

TRANSMITTER PARTS LIST

B1 Lithium 3.3-volt coin cell, Digi-Key P191-ND or equivalent
C1 0.1 uFd 50-volt ceramic disc capacitor
C2 0.0047 uFd 50-volt mylar or polyester capacitor
R1 100K 1/4-watt 1% metal film resistor
R2 49.9K 1/4-watt 1% metal film resistor
RF Module 1 Linx TXM-418-LC
S1 SPST push-button switch, Digi-Key P8012S-ND or similar
U1 Encoder, Motorola MC145026P
Enclosure Polycase P/N FB-30T0 or similar
Wire antenna (see text)

RECEIVER PARTS LIST

C3 47 uFd 25-volt radial electrolytic capacitor
C4, C5, C7 0.1 uFd 50-volt ceramic disc capacitor
C6 0.022 uFd 50-volt mylar or polyester capacitor
D1, D2, D3, D4 1N4004 or similar silicon diode
K1 12-volt SPST relay, Digi-Key 255-1114-ND or similar
LED1 Light emitting diode, general purpose
Q1 N channel MOSFET, BS170
R3 42.2K 1/4-watt 1% metal film resistor
R4 221K 1/4-watt 1% metal film resistor
R5 470K 1/4-watt carbon resistor
R6 200 ohm 1/4-watt carbon resistor
R7 2.2K 1/4-watt carbon resistor
RF Module 2 Linx RXM-418-LC-S
U2 Decoder, Motorola MC145028P
U3 5-volt linear regulator, 78L05
U4 JK Flip-Flop, CD4013BE
T1 12.6-volt step-down transformer, Digi-Key T601-ND or similar
Misc: Enclosure, hook-up wire, antenna (see text)

SOURCES OF SUPPLY

Digi-Key 1-800-344-3439; www.digikey.com
Mouser 1-800-346-6873; www.mouser.com
Polycase 1-800-248-1233; www polycase.com

Note: The following parts are available from **A. Caristi, 69 White Pond Road, Waldwick, NJ 07463.** Set of two etched and drilled PC boards @ $19.75, U1 @ $5.50, U2 @ $5.50, U3 @ $2.50, U4 @ $2.50. Transmitter RF module @ $11.95, Receiver RF module @ $19.95. Transmitter enclosure @ $7.50. Please add $6.00 postage/handling.

RECEIVER ASSEMBLY

Refer to Figures 3 and 4, the printed layout and parts location for the receiver board. Figures 4 and 5 illustrate the orientation and terminal identification of Q1 and U3. Carefully solder all components — except the RF module — in place. Sockets may be used for the integrated circuits, if desired. Be sure all polarized components are properly positioned as indicated in Figure 4. Any part placed backwards in the circuit will render the receiver inoperable, and may cause damage to components.

The single pole double throw (SPDT) contacts of the relay are connected to pads on the foil pattern that are not dedicated to any part of the circuit. It is up to the builder to wire these pads in accordance with the desired circuit that is to be controlled. Figure 6 illustrates a simple lamp control circuit. The suggested relay contacts are able to handle up to 10 amperes in a 120-volt AC circuit. IMPORTANT: The foil pattern is able to carry only about an ampere or so. If the load circuit draws more than this, use 18 gauge wire and solder directly to the terminals of the relay. It is recommended that a fuse be installed in the circuit for protection against accidental short circuits.

The circuit is powered by a source of 12-volts AC, derived from a step-down transformer. Load current for the circuit is about 50 milliamperes when the relay coil is activated. The Parts List illustrates one possible wall type transformer that can be used. A power switch may be included in the circuit, if desired.

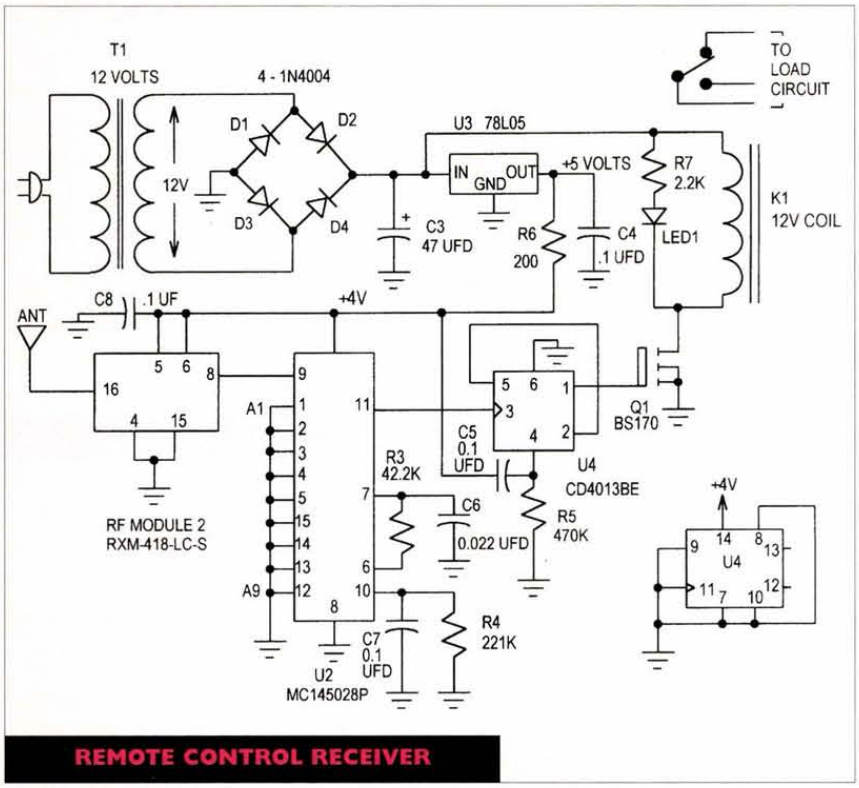
If it is desired to power the receiver from a 12-volt DC source, it may be done so by using the same PC pads as for AC, without regard to polarity. Alternatively, the diode bridge may be deleted from the circuit and the positive lead of the DC power source connected to the positive side of C3. The negative side of the supply would then be connected to circuit common.

The receiver circuit board may be installed in a suitably-sized plastic enclosure. If desired, the LED may be mounted to the outside of the enclosure so that it is readily visible. The antenna can be composed of a six-inch length of stiff wire connected to pin 5 of the RF module. Refer to the section below, concerning antennas, which may be used for both transmitter and receiver.

When finished assembling and wiring the receiver, check it thoroughly for proper wiring and components. Correct any problems now. Place the receiver aside until the check-out procedure is performed later. The RF module will be installed at that time.

ANTENNAS

The performance of this remote control system depends largely on the type of antenna that is used both in the transmitter and in the receiver. Best results are obtained when the antenna is "tuned' to the fre-



REMOTE CONTROL RECEIVER

quency of operation, so that it will emit or receive maximum RF energy.

One type of antenna that is commonly used is the quarter wave whip, or ground plane antenna. Using an accepted formula for wavelength at 418 MHz, a quarter wavelength antenna would be 6.7 inches long. It would usually be no problem to outfit the receiver with an antenna of this length. However, the transmitter is constructed in compact form and such an antenna length is not practical.

One type of antenna that will fit into a compact space is the loop style. Refer to Figure 7. Such an antenna is easily constructed by taking a 7/8 inch by one inch piece of stiff paper, and punching two holes in each corner with a needle. Then take a 6-1/2 inch piece of #22 enamel wire and weave it into the paper, as shown. Connect one end of the wire to the antenna pad on the PC board. Then place the coiled antenna in the space next to the RF module on the printed layout side of the board. Make sure the cut end of the wire does not short out to any part of the circuit. Remember, using a compact antenna as described will not allow as much operating range as that of a quarter wave whip antenna. The builder can experiment with different antenna styles to determine the practical operating range as compared to the performance of the quarter wave whip.

TRANSMITTER CHECK-OUT

The transmitter must be checked first so that it may be used for receiver testing. Examine the transmitter assembly carefully for opens, shorts, and bad solder connections. Pay attention to all non-grounded leads (especially the positive battery terminal) that pass through the ground plane, to be sure there is sufficient clearance. Any solder joint that is not shiny and smooth is suspect. Correct by removing the solder with braid and applying new solder. It is much easier to correct assembly problems now rather than later on if you discover that your remote control system does not work.

Before installing the battery into the transmitter board, use an ohmmeter to measure the resistance between pin 16 of U1 and circuit common. Normal reading will be essentially open circuit. If a low-resistance reading is obtained, examine the assembly very carefully to locate and correct any possible fault. When you are satisfied that the circuit is properly assembled, insert the battery into the pads provided for this part and solder it in place. Be sure to observe proper polarity as indicated in Figure 2. Use a DC voltmeter to be sure.

If desired, an oscilloscope may be used to verify the presence of the transmitting pulse train that appears at pin 15 of U1 when S1 is activated and held down. Normal indication is a train of pulses with a pulse repetition rate (PRF) of about 20 per second. If no waveform is present, check battery voltage and polarity. Check the orientation of U1, and verify that the resistors and capacitor are correct in value. If the waveform is normal, proceed with receiver checkout.

RECEIVER CHECK-OUT

Check the receiver board for shorts, opens, and bad solder connections. Correct any problems now. The first test of the receiver board is to ensure that the five-volt regulated supply is operating properly. This must be done without the RF module in place, to assure that it will not be damaged by excessive voltage,

Apply 12 volts AC or DC power to the circuit at the two foil pads as indicated in Figure 4. Measure the DC voltage — with respect to circuit common — at the positive end of C3. Normal indication is about +12 to +16 volts. Measure the DC voltage at the output terminal of U3. Normal indication is 4.75 to 5.25 volts.

If you do not obtain the correct voltage readings, disconnect power and repair the fault before proceeding. Check the orientation of C3, D1 through D4, U2, and U3. When the fault has been corrected and the five-volt regulator circuit is working properly, proceed to the installation of the RF module.

Refer to the instructions for installation of the transmitter RF module, and install the receiver module in place observing proper orientation. IMPORTANT: Solder only pins 4, 5, 6, 8, 15, and 16. All other terminals are unused and must not be soldered. When done, check the circuit for solder shorts and bad connections. Apply 12 volts AC or DC power to the circuit. The LED should be off, and the relay not energized.

Stand a few feet away from the receiver, press and hold the transmitter switch for one-half second. The LED should be illuminated, indicating that the relay is energized. Press the transmitter switch once again for one-half second. The LED should be extinguished. Repeat the test for greater and greater distance between the transmitter and receiver.

If the circuit performs as indicated, the check-out procedure is completed. If not, remove power from the receiver and visually check the board for improper components and/or improper orientation of U3, U4, LED1, and the RF module. If necessary, use an oscilloscope to verify that the data input terminal of U2, pin 9, is receiving the detected pulse train. Check that the valid data terminal of U2, pin 11, goes high when the transmitter switch is held down. Check that both transmitter and receiver are hardwired for identical addresses.

USING THE REMOTE CONTROL SYSTEM

When power is first applied to the receiver, the relay will be unenergized and the LED will be off. The transmitter switch is pressed and held for one-half second to toggle the relay and light the LED. When the transmitter switch is pressed and released again, the circuit returns to the unenergized position. This sequence may be repeated as many times as desired. Figure 6 illustrates one possible circuit that can be used to control a lamp. Any other electrical device may also be controlled providing that the total current handled by the relay contacts is less than 10 amperes.

The operating distance of the system can be as much as 300 feet when using ideal antennas, and line-of-sight range. If the RF is required to pass through objects, the distance will be shorter. A simple test of the system using a lamp as an indicator, will quickly reveal the practical operating range of the system. **NV**

Continued from Page 12

```
' Http://www.acroname.com
' Devantech SRF04 Example
'

wDist   var     word

INIT    con     0
ECHO    con     1


' CONVERSION FACTORS:
'
' The PULSIN command returns the round-trip echo time in 2us units
' which is equivalent to the one-way trip time in 1us units.
'
' distance = (echo time) / (conversion factor)
'
' use 74 for inches       (73.746us per 1 in)
' use 29 for centimeters  (29.033us per 1 cm)
'

convfac con     74      ' use inches



'_____________________________
```

Listing 1

```
main

        gosub sr_sonar
        debug dec wDist, cr
        pause 200
        goto main


sr_sonar:

        pulsout INIT,5              ' 10us init pulse
        pulsin ECHO,1,wDist         ' measure echo time
        wDist=wDist/convfac         ' convert to inches
        pause 10
        return

sr_sonar_2:

        pulsout INIT,5              ' 10us init pulse
        output INIT                 ' dummy command (delay)
        rctime ECHO,1,wDist         ' measure echo time
        wDist=wDist/convfac         ' convert to inches
        pause 10
        return
```

```
'3/27/2001
'devantech SRF04 Tone Generation program
'Speaker on pin 1
'Init pin on 4
'Echo pin on 5
'Conversion factors; 74 for inches, 29 for centimeters
wdist var word
wdistold var word
sound var word
hz var word
init con 4
echo con 5
convfac con 74    'conversion factor for inches
speaker con 1

MAIN
gosub sr_sonar
'debug dec wdist, cr
freqout 1,200,sound
pause 200
goto main

SR_SONAR
pulsout init, 5     '10us init pulse
output init
rctime echo,1,wdist
wdist = wdist/convfac       'convert to inches
if wdist < 10 then object
sound = wdist * 100
pause 10
return

OBJECT
'Play this sound if an object has been detected
for Hz = 1 to 4000 step 1000
freqout speaker,70,hz,4000-hz
next
goto main
```

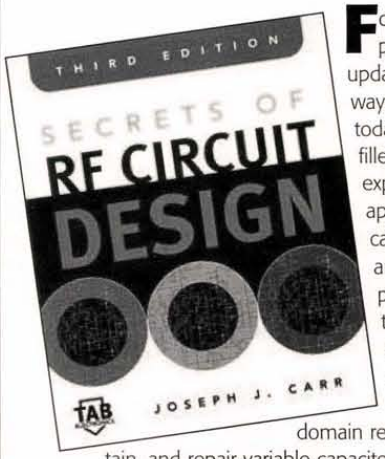
Listing 2

SRF04, and a speaker in Listing 2. I carried this around with me and actually tested the SRF04 detection capabilities in the real world. I was then able to point the ranger at trees, chair legs, couches, etc, and hear exactly what the ranger was doing. Methods such as this are always handy so that you can tell for yourself exactly what your robot is receiving. If you cannot understand the data output, your robot will certainly not be able to either.

Users may be curious of the speed of detection using the SRF04 and a Stamp. Using the sound driven program in Listing 2, I can pass my hand in front of the detector at a moderate rate and receive detection every time. Passing a hand in front of the detector very fast will occasionally miss detections. This is not a fault of the detector but is dependent on the Stamp and its software code. I wish to point this out so people will realize that for a small, home-based robot using a Stamp, detection speed is more than adequate. If you try to detect objects on a high-speed robot used for robot wars, you may have problems. In this case, most everyone uses assembly-based processors, and the SRF04 will perform nicely. Design parameters listed are always nice, I have, however, attempted here to give a real world example of the detection capability. I wish to give credit to Acroname for the use of their photographs, schematics, and beam patterns. Acroname is a good company to deal with. I believe they enjoy using their products as much as selling them. If you are looking for a simple-to-use, yet highly effective sensor, try the DEVANTECH SRF04. **NV**

SolderingDesoldering.Com
Your SMD Rework Specialist
800-394-1984

Secrets of RF Circuit Design
by Joseph J. Carr



Following up on the best-selling previous editions, this revised and updated guide gives you the best ways to design, build, and test today's radio frequency circuits. It's filled with functional projects and experiments that make it easy to apply RF principles to real-life applications. Joe Carr provides parts lists and component sources for every project, in chapters that cover how to: Design and build radio receiver circuits, RF bridges, amplifiers, receiver preselectors, simplified spectrum analyzers, and time domain reflectometers; Select, use, maintain, and repair variable capacitors; Design and wind inductor coils for radio circuits; Construct and ground simple wire antennas.

only $39.95

Amazon.com reviews:

"Great for the RF technician. This is a great book on wireless technology for persons starting out in RF electronics, as well as for RF technicians and ham radio operators. Carr's book explains RF capacitors, coils, transistors, receivers, propagation, antennas, mixers, amplifiers, impedance matching, filters, the Smith Chart, etc., in an easy-to-understand way."

This book takes you inside wireless technology with step-by-step, illustrated directions for dozens of usable projects.

PERFECT FOR TECHNICANS, RADIO HOBBYISTS, AND ANYONE WHO WANTS TO PUT RF THEORY INTO PRACTICE

Advertiser INDEX

Abacom Technologies 80
ActiveWire, Inc. 43
All Electronics Corp. 34
Alltronics 58
Andromeda Research 21
Autotime Corp. 57
Barrett Instruments 43
Basic Micro, Inc. 4, 80
Blue Bell Design, Inc. 80
C & S Sales, Inc. 31
CCTV Outlet 37
Circuit Specialists, Inc. 82
Cleveland Institute of Electronics 8
Conitec DataSystems 18
Consumertronics 42
Corporate Systems Center 2
Cunard Associates 41
DesignNotes.com 63
Designtech Engineering 8
Detection Dynamics 56
DLP Design 46
Earth Computer Technologies 42
ECD 42
E.H. Yost & Co. 18
Electro Mavin 63
Electronic Design Specialists 46
Electronix Express 66
EMAC, Inc. 13
E Tip, Inc. 56
ExpressPCB 50
Fair Radio Sales Co. 57
Future Horizons 12
Gateway Electronics, Inc. 12, 65
Halted Specialties Co. 3
Hitechcafe.com 12
H.T. Orr Computer Supplies 41
HVW Techonolgies, Inc. 43
IndustroLogic 17
Information Unlimited 29
Inkjet Southwest 33
Intronics, Inc. 41
LabJack 13
Lemos International 42-43
Linear Systems 13
Lynxmotion, Inc. 25
M2L Electronics 47
Matco, Inc. 43
MEM Electronics 57
Meredith Instruments 65
microEngineering Labs 12
Micromint 7
Mouser Electronics 50
Mr. NiCd 18
MVS 58
Parallax, Inc. ....Back Cover
PAiA Electronics 43
Polaris Industries 19
Prairie Digital, Inc. 43
Pulsar, Inc. 43
Quality Kits 42
R4 Systems, Inc. 42
Ramsey Electronics, Inc. 49
Resources Un-Ltd. 27
Saelig Company 66
Scott Edwards Electronics, Inc. 55
SGC 21
Shreve Systems 28
SolderingDesoldering.com 7, 40, 71
Square 1 Electronics 40
Technological Arts 47
Test Equipment Connection 46
Texas Instruments 9
The RF Connection 29
Timeline, Inc. 21
TNR Technical, Inc. 25
Unicorn Electronics 12
V & V Machinery & Equip., Inc. 42, 43
Velleman, Inc. 41
Viking Systems International 17
Western Test Systems 14-15
Wittig Technologies, Inc. 8, 40, 63, 80

Your company could be listed here too. Call us *today* for advertising information. 909 371-8497

AMATEUR RADIO & TV

Alltronics 58
E Tip, Inc.. 56
Gateway Electronics, Inc. 12, 65
Hitechcafe.com. 12
Ramsey Electronics, Inc. 49
SGC 21
The RF Connection 29

ASSEMBLY SERVICES

BATTERIES/CHARGERS

Cunard Associates 41
E.H. Yost & Co. 18
Mr. NiCd 18
TNR Technical, Inc. 25

BUSINESS OPPORTUNITIES

BUYING ELECTRONIC SURPLUS

Earth Computer Technologies. 42
Timeline, Inc. 21

CABLE TV

CB/SCANNERS

CCD CAMERAS/VIDEO

Autotime, Corp. 57
CCTV Outlet 37
Circuit Specialists, Inc. 82
Detection Dynamics 56
Matco, Inc. 43
MEM Electronics 57
Polaris Industries 19
Ramsey Electronics, Inc. 49
Resources Un-Ltd. 27
Timeline, Inc. 21

CIRCUIT BOARDS

Cunard Associates 41
ECD 42
ExpressPCB 50
IndustroLogic 17
Pulsar, Inc. 43
R4 Systems, Inc. 42
V & V Machinery & Equipment, Inc. 42, 43

COMPONENTS

ECD 42
Electronix Express 66
Linear Systems 13
Pulsar, Inc. 43
Unicorn Electronics 12

COMPUTER

Hardware

ActiveWire, Inc. 43
Autotime, Corp. 57
Corporate Systems Center 2
Earth Computer Technologies 42
Electro Mavin 63
Halted Specialties Co. 3
Shreve Systems 28

Software

Consumertronics 42
R4 Systems, Inc. 42

Microcontrollers / I/O Boards

Abacom Technologies 80
Basic Micro, Inc. 4, 80
Conitec DataSystems 18
DLP Design 46
EMAC, Inc. 13
IndustroLogic 17
microEngineering Labs 12
Micromint 7
MVS 58
Parallax, Inc. .... Back Cover
Prairie Digital, Inc. 43
Scott Edwards Electronics, Inc. 55
Square 1 Electronics 40
Technological Arts 47
Texas Instruments 9

Printers/Printer Supplies

H.T. Orr Computer Supplies 41
Inkjet Southwest 33

DESIGN/ENGINEERING SERVICES

DesignNotes.com 63
ExpressPCB 50
IndustroLogic 17
Prairie Digital, Inc. 43
Pulsar, Inc. 43
V & V Machinery & Equipment, Inc. 42, 43

EDUCATION

Cleveland Institute of Electronics 8
EMAC, Inc. 13
R4 Systems, Inc. 42

EVENTS/SHOWS

KITS

Alltronics 58
Autotime, Corp. 57
C & S Sales, Inc. 31
Earth Computer Technologies 42
EMAC, Inc. 13
Future Horizons 12
Gateway Electronics, Inc. 12, 65
HVW Technologies, Inc 43
Information Unlimited 29
Inkjet Southwest 33
PAiA Electronics. 43
Quality Kits 42
Ramsey Electronics, Inc. 49
Scott Edwards Electronics, Inc. 55
Velleman, Inc. 41

LASERS

Future Horizons 12
Information Unlimited 29
Meredith Instruments 65
Resources Un-Ltd. 27
Unicorn Electronics 12

MISC./SURPLUS

All Electronics Corp. 34
Designtech Engineering 8
Fair Radio Sales Co. 57
Gateway Electronics, Inc. 12, 65
Halted Specialties Co. 3
Linear Systems 13
Resources Un-Ltd. 27
Shreve Systems 28
SolderingDesoldering.com 7, 40, 71
Timeline, Inc. 21
Unicorn Electronics 12
Viking Systems International 17

PROGRAMMERS

Andromeda Research 21
Conitec DataSystems 18
HVW Technologies, Inc 43
Intronics, Inc. 41
M2L Electronics 47
microEngineering Labs 12
Basic Micro, Inc. 4, 80

PUBLICATIONS

Consumertronics 42
Future Horizons 12
Mouser Electronics 50
Texas Instruments 9
Square 1 Electronics 40

RF TRANSMITTERS/ RECEIVERS

Abacom Technologies 80
E Tip, Inc.. 56
Lemos International Co., Inc. 42, 43
Matco, Inc. 43

ROBOTICS

Blue Bell Design, Inc. 80
HVW Technologies, Inc 43
LabJack 13
Lemos International Co., Inc. 42, 43
Lynxmotion, Inc. 25

SATELLITE

SECURITY

CCTV Outlet 37
Consumertronics 42
Detection Dynamics 56
E Tip, Inc.. 56
Information Unlimited 29
Lemos International Co., Inc. 42, 43
Matco, Inc. 43
MEM Electronics 57
Polaris Industries 19

STEPPER MOTORS

Alltronics 58

TELEPHONE

TEST EQUIPMENT

Barrett Instruments 43
C & S Sales, Inc. 31
Circuit Specialists, Inc. 82
Conitec DataSystems 18
DesignNotes.com 63
Electronic Design Specialists 46
Intronics, Inc 41
LabJack 13
Prairie Digital, Inc. 43
Saelig Company. 43
Test Equipment Connection 46
Western Test Systems 14-15
Westshore Technologies 43
Wittig Technologies, Inc. 8, 40, 63, 80

TOOLS

C & S Sales, Inc. 31
The RF Connection 29
SolderingDesoldering.com 7, 40, 71

WIRE/CABLE & CONNECTORS

The RF Connection 29

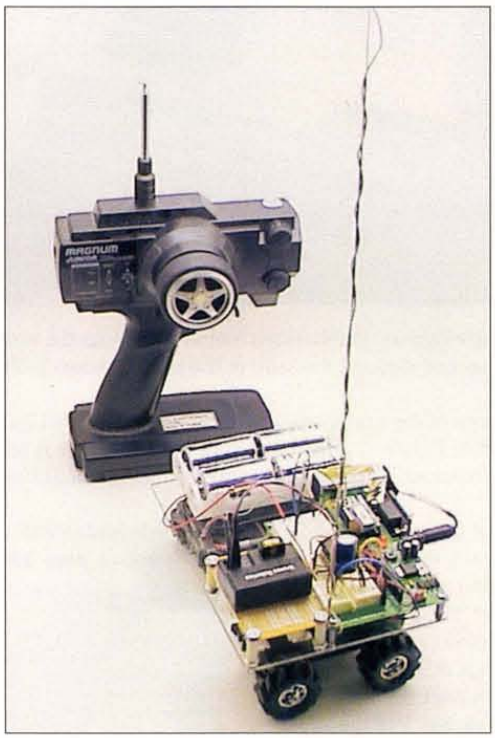
Interfacing an RC Receiver

By Michael Simpson

How do I connect my RC gear to my bot? Question asked, and answered ...

In the last few months, I have been working with the Kronos Crawler and the one single question I keep getting is how do I connect my RC gear to my bot? For this application, I will once again be using my microcontroller of choice — the Atom from Basic Micro so that I can take advantage of the built-in PWM generators.

In an attempt to make this article not bot-specific, I'm going to not use the Kronos Crawler. Instead, I will be using the SN754110 motor controller and a small bot that I threw together for this article. All code and hook-up examples should apply to any two-motor bot.



Decide on the Gear

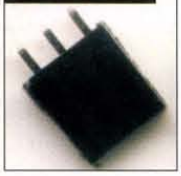
First, you must decide on the radio gear. I decided on a Futaba two-channel AM transmitter and receiver because of its popularity and the fact that I had several lying around. Just about any radio will work, but it must have BEC ability. That is, it must be able to draw power from the channel 2 servo connector. And while this is not an absolute requirement, it does eliminate the need for an additional battery.

Radio Hook-up

After deciding on a radio, it's time to hook it up. And again, this will depend on the radio you are using since the servo connector pin-outs are different from manufacturer to manufacturer. Again, my examples and diagrams are based on the Futaba design. Please consult your owner's manual to verify pin-outs on your receiver.

I was not in any hurry to cut the connectors from any of my servos, so I decided to make a couple. Making your own connectors is very easy if you have the right parts.

Figure 1



You will need a small three-pin header (Figure 1), some shrink tubing, and some 22-24 gauge hook-up wire.

Start by cutting three wires about 6" long. You will need a red, black, and green wire. Strip about 1/16" from the end of each wire and solder them to the leads of the header as shown in Figure 2. Keep in mind that the red lead connects to the middle for Futaba radios.

Figure 2

Figure 3

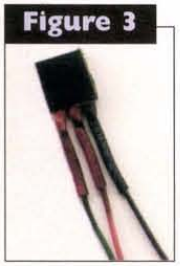
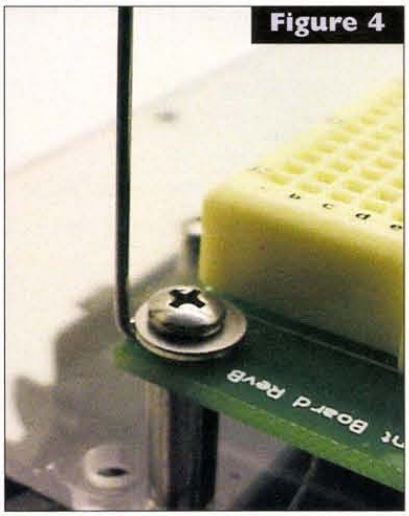


Figure 4



If you can't find any three-pin headers, you can make them by cutting larger headers down. Just make sure you test fit the connectors before you solder the wires.

Now place some 1/16" heat shrink over each of the connections and heat as shown in Figure 3. This will help strengthen the connection and aid you in identifying the pins on the connector.

You will need to create two connectors.

Take a piece of 1/32" diameter piano wire and cut it down to about 14". Place a loop on both ends and bend one of them 45 degrees and attach to your platform as shown in Figure 4.

Attach your radio to your platform as close to the antenna wire as

Figure 5

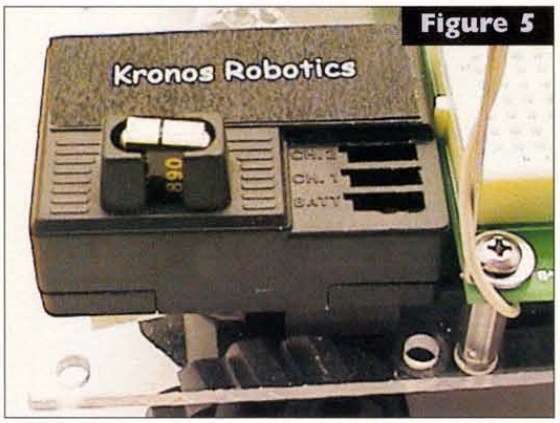


Figure 6

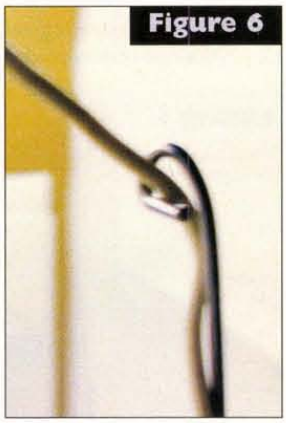
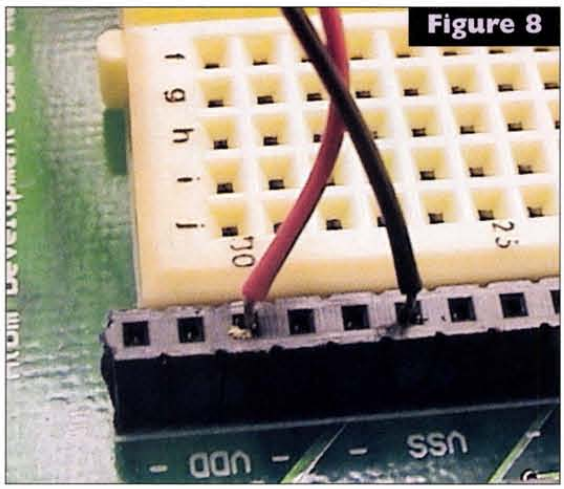


Figure 7

Figure 8



possible. I used some double-sided foam tape. Wrap the wire around the antenna wire and through the loop in the top as shown in Figures 5 and 6.

Insert one of the connectors you made into channel 2 of the receiver as shown in Figure 7. Just make sure the black wire is facing the outside of the receiver. Consult your owner's manual for actual pin assignments.

Connect the red lead to VDD and the black lead to VSS on the development board as shown in Figure 8. These two pins will supply the power to the receiver.

Connect the green wire to P3 on the development board as shown in Figure 9.

Now connect the second connector to channel 1 of the receiver as shown in Figure 10. We will only be using the green wire on this connector. Connect that green wire to p4 on the development board.

Schematic 1 shows the complete wiring hook-up for Listings 1 and 2.

In Listing 1, we will look at the raw numbers as they are read from the microcontroller. The output will be the raw pulse width values of channel 1 and 2 of the receiver.

Activate the steering and throttle on the transmitter to determine the center position of each channel. In my case, it seemed to be around 1500. You can change this with the steering and throttle trims.

In Listing 2, things get a bit more complicated. Most two-channel radios are designed to be used with an RC vehicle that has a single drive motor and a steering servo. What we have to do is convert these two channels into a control for a two-motordrive Bot.

All variables beginning with "throt" are used for throttle calculations. Variables beginning with "st" are for steering.

The first thing the program does is call the routine calrcvr. This routine calculates the center position and sets up a few variables so the rest of the program knows when some sort of control deviation occurs.

It also loads up a multiplier for PWM speed control when using a PWM motor controller.

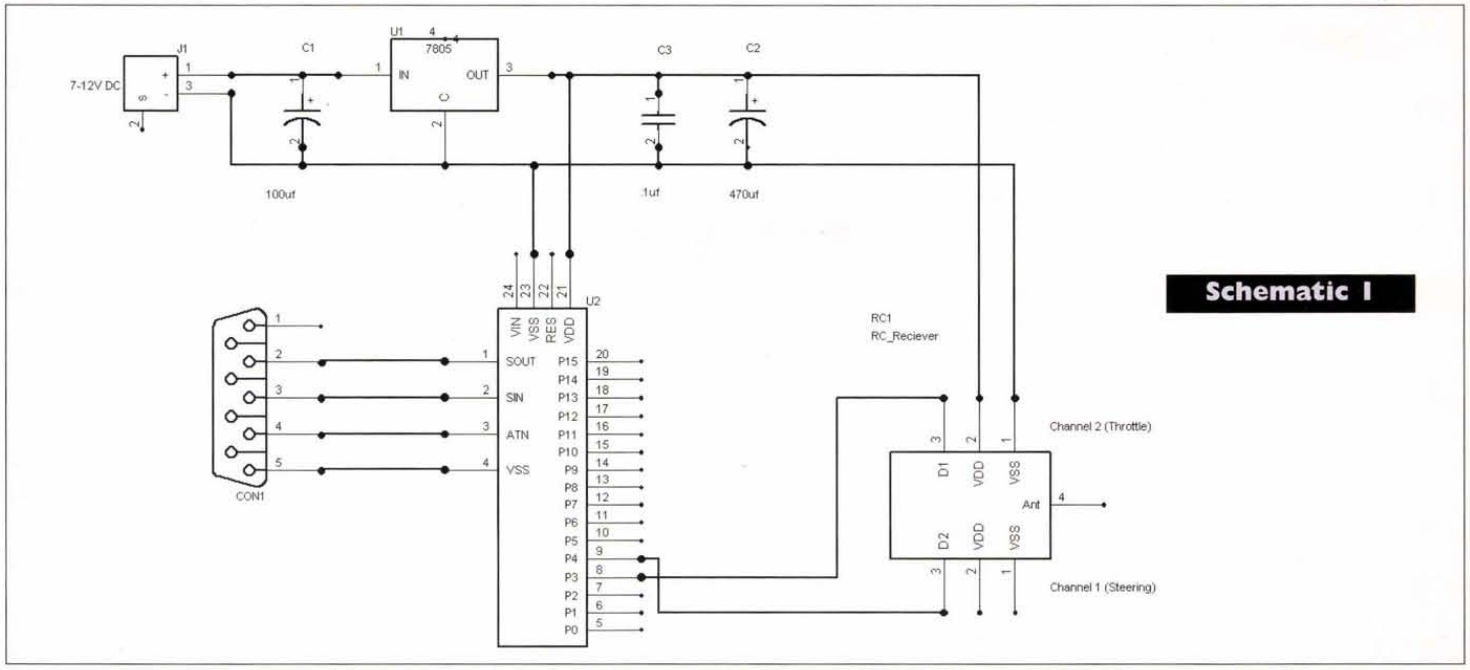
Another parameter of note is called deadband. This is how much

Listing 1

```
throtval var word
stval var word

main:

  pulsin 3,1,throtval
  pulsin 4,1,stval
  serout s_out,i9600,["TH:",dec throtval,"
ST:",dec stval,10,13]

Goto main
```

Listing 2

```
deadband con 5

throtctr var word
throtval var word
throtspeed var word
throtdir var byte
thspeedmult var word

stctr var word
stval var word
stspeed var word
stdir var word
stspeedmult var word

speeddutyl var word
speeddutyr var word

throtdir =1
stdir = 1

'These variables setup low and high speeds for the PWM motor 'controller.
lowspeed con 2000
highspeed con 10000

gosub calrcvr


main:

  pulsin 3,1,throtval:throtval = throtval /10
  pulsin 4,1,stval:stval=stval/10

  '-----------------------------------------------------
  'Throttle Calculations
  '-----------------------------------------------------

  'Calculate throttle speed
  if throtval > throtctr then
    throtspeed = throtval - throtctr
  elseif throtval < throtctr
    throtspeed = throtctr - throtval
  else
    throtspeed = 0
  endif

  'Calculate throt dir (back, fwd)
  if throtspeed > deadband then
    'First find out direction (fwd or bkward)
    if throtval < throtctr then
      throtdir = 1 ' fwd
    else
      throtdir = 0 'bkwd
    endif

  else
    throtspeed = 0
  endif

  '-----------------------------------------------------
  'Turn Calculations
  '-----------------------------------------------------
  if stval > stctr then
    stspeed = stval - stctr
  elseif stval < stctr
    stspeed = stctr - stval
  else
    stspeed = 0
  endif

  'Calculate turn dir (back, fwd)
  if stspeed > deadband then
    'First find out direction (fwd or bkward)
    if stval < stctr then
      stdir = 1 ' fwd
    else
      stdir = 0 'bkwd
    endif

  else
    stspeed = 0
  endif

  serout s_out,i9600,["Throt: dir=",dec throtdir," ThSp=",dec _
  throtspeed,"  Steer:"]
  serout s_out,i9600,["dir=",dec stdir," Sp=",dec stspeed,10,13]


Goto main

'This routine calculates the center pos.
calrcvr:
  pulsin 3,1,throtctr : throtctr = throtctr/10
  pulsin 4,1,stctr : stctr = stctr/10

  thspeedmult = (highspeed - lowspeed) / 50

  stspeedmult = (highspeed - lowspeed) / 30

return
```



Schematic 1

control deviation must occur before the bot starts to move. Before running this program, make sure the transmitter is on so that the calibration routine can do its job.

In Listing 3, we take it one step further and actually start to control the SN754110 motor controller via PWM as shown in Schematic 2.

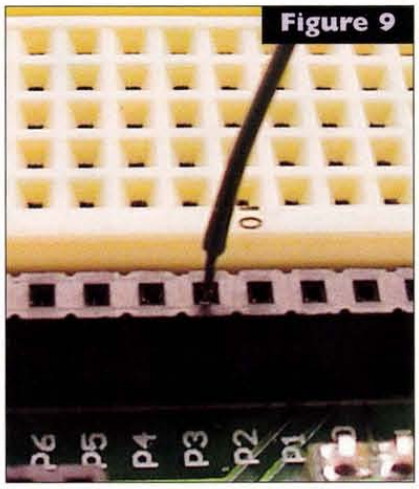
The important portion of this code is the Bot Movement Calculations section. Here we take the calculated direction variables along with the calibrations modifiers to create a PWM duty parameter for the two PWM signal generators built into the Atom.

That's about all I have time for this month. So make sure you check out the website for updates and code enhancements.

One final thought is on radio glitches. The radio I used was a very inexpensive AM radio. Its range is only about 30 feet. One area of enhancement would be to monitor the receiver readings and dampen them a bit to prevent glitching. **NV**

Continued next page

Figure 9



Schematic 2

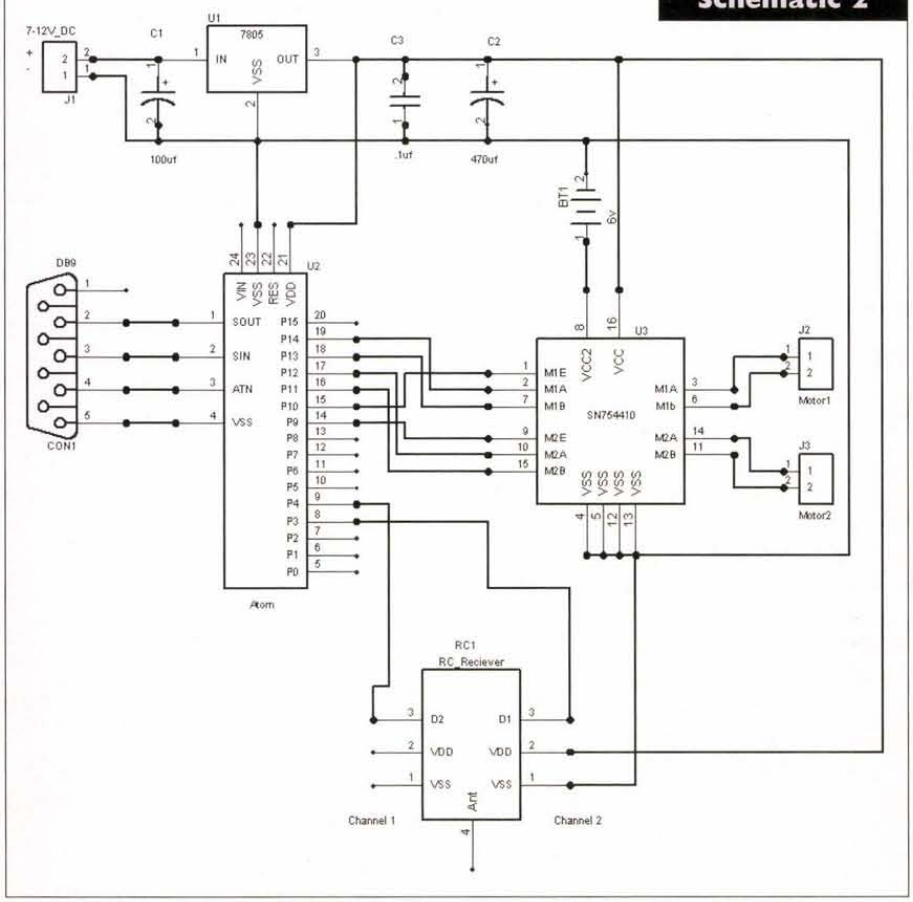
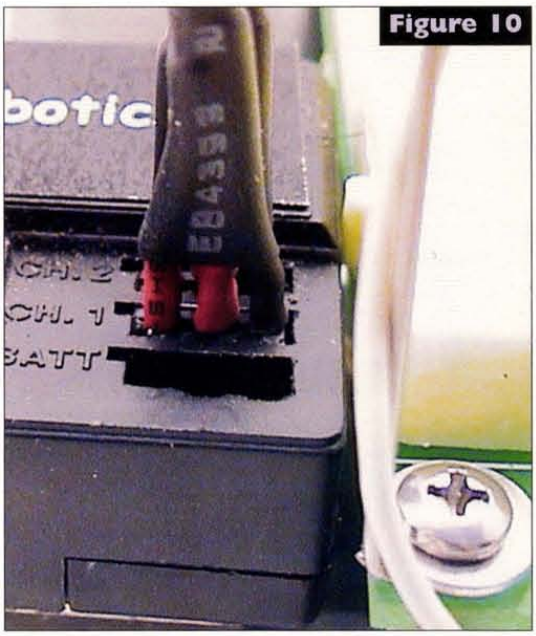


Figure 10



The Parts

All items listed below are available from Kronos Robotics; **www.kronosrobotics.com**

Item	Qty	Description	Part#
U1	2	SN754410 Motor Controllers	
		At least two depending on Bot Base	#MDR1
	2	Headers (three-pin)	#H4
U2	1	Atom	#ATM1
	1	Atom development board	#ATM3
C1	1	100uF Capacitor	#C100-50
C2	1	.1uF Capacitor	#C.1-50
C3	1	470uF Capacitor	#C470-50
	1	Dip Heatsink	#HSDIP
	1	9V battery connector with power connector	#CO5
RC Gear	1	Transmitter and Receiver	Local Hobby shop

Note that even though you may be using the Atom (www.basicmicro.com) or other development board, the capacitors C1-C3 are still required. Place C3 as close to the receiver as possible.

Listing 3

```
'-----------------------------------------------------
'  Motor Settings
'-----------------------------------------------------
'-------- Sets up the constants for the motor controller
M2InputA Con 12
M2InputB Con 11

M1InputA Con 14
M1InputB Con 13

'-------- Setup the ports for motor controller
Output M1InputA
Output M1InputB

Output M2InputA
Output M2InputB

'-------- Setup the initial speed
gosub CrHigh

deadband con 5

throtctr var word
Throtval var word
throtspeed var word
throtdir var byte
thspeedmult var word

stctr var word
stval var word
stspeed var word
stdir var word
stspeedmult var word

'These routines set the min and max duty cycle for speed and turn
'ratio calculations.
lowspeed con 2000
highspeed con 10000

speeddutyl var word
speeddutyr var word

throtdir =1
stdir = 1


gosub calrcvr

main:


  pulsin 3,1,throtval:throtval = throtval /10
  pulsin 4,1,stval:stval=stval/10


  '-----------------------------------------------------
  'Throttle Calculations
  '-----------------------------------------------------

  if throtval > throtctr then
    throtspeed = throtval - throtctr
  elseif throtval < throtctr
    throtspeed = throtctr - throtval
  else
    throtspeed = 0
  endif

  'Calculate throt dir (back, fwd)
  if throtspeed > deadband then
    'First find out direction (fwd or bkward)
    if throtval < throtctr then
      throtdir = 1 ' fwd
    else
      throtdir = 0 'bkwd
    endif

  else
    throtspeed = 0
  endif

  '-----------------------------------------------------
  'Turn Calculations
  '-----------------------------------------------------
  if stval > stctr then
    stspeed = stval - stctr
  elseif stval < stctr
    stspeed = stctr - stval
  else
    stspeed = 0
  endif

  'Calculate turn dir (back, fwd)
  if stspeed > deadband then
    'First find out direction (fwd or bkward)
    if stval < stctr then
      stdir = 1 ' fwd
    else
      stdir = 0 'bkwd
    endif

  else
    stspeed = 0
  endif


  '-----------------------------------------------------
  'Bot movement calculations
  '-----------------------------------------------------

  'First calculate base speed only if throttle is pressed
  if throtspeed > 0 then
    speeddutyl = throtspeed*thspeedmult
    speeddutyr = throtspeed*thspeedmult

  'Now calculate the track turn ratio if any

    if stspeed > 0 then
      if stdir = 1 then
        speeddutyl = speeddutyl - (stspeed*stspeedmult)
      else
        speeddutyr = speeddutyr - (stspeed*stspeedmult)
      endif
    endif


  'Just incase we go over
    if speeddutyl > 20000 then
      speeddutyl = 0
    endif

    if speeddutyr > 20000 then
      speeddutyr = 0
    endif


  'Set the speed
    HPWM 1,10000,lowspeed+speeddutyl
    HPWM 0,10000,lowspeed+speeddutyr


  'Now set motor direction
    if throtspeed > 0 then
      if throtdir = 1 then
        gosub crfwd
      else
        gosub crrev
      endif
    else
      gosub crstop
    endif

  'This we do if the throttle not pressed
  elseif stspeed > 0

      'Set the base speed
      speeddutyl = (stspeed*stspeedmult) - 2000
      speeddutyr = (stspeed*stspeedmult) - 2000


      'Set the speed
      HPWM 1,10000,lowspeed+speeddutyl
      HPWM 0,10000,lowspeed+speeddutyr

      if stdir=0 then
        gosub CrLspin:
      else
        gosub CrRspin

      endif



  else
    speeddutyl=0
    speeddutyr=0


  'Set the speed
    HPWM 1,10000,lowspeed+speeddutyl
    HPWM 0,10000,lowspeed+speeddutyr
    gosub crstop
  endif


Goto main


'This routine calculates the center pos.
calrcvr:
  pulsin 3,1,throtctr : throtctr = throtctr/10
  pulsin 4,1,stctr : stctr = stctr/10

  thspeedmult = (highspeed - lowspeed) / 50

  stspeedmult = (highspeed - lowspeed) / 30

return


'-----------------------------------------------------
' Motor Routines
'-----------------------------------------------------

'-------------------------------------
'  Speed routines
'  You can tweek the left and right tracks if
'   find the crawler pulls to left or right.
'-------------------------------------
Crlow:
  HPWM 1,10000,7500 'Left track
  HPWM 0,10000,7500  'Right track
  return

CrMed:
  HPWM 1,10000,8000  'Left track
  HPWM 0,10000,8000  'Right track
  return

CrHigh:
  HPWM 1,10000,10000  'Left track
  HPWM 0,10000,10000  'Right track

  return

'-------------------------------------
' Crawler movement routines
'-------------------------------------

Crfwd:
  gosub rfwd : gosub lfwd : return

Crrev:
  gosub rrev : gosub lrev : return

CrLspin:
  gosub rfwd : gosub lrev : return

CrRspin:
  gosub rrev : gosub lfwd : return

Crstop:
  gosub loff: gosub roff : return


'-------------------------------------
'         Motor Routines
'-------------------------------------

'-------------Left Motor (M1)
Lfwd:
  High M1InputA : Low M1InputB : Return

Lrev:
  Low M1InputA : High M1InputB : Return

Loff:
  Low M1InputA : Low M1InputB : Return

'------------ Right Motor (M2)
Rfwd:
  High M2InputA : Low M2InputB : Return

Rrev:
  Low M2InputA : High M2InputB : Return

Roff:
  Low M2InputA : Low M2InputB : Return
```

by Robert Nansel

Amateur Robotics

This month, I have two items of business. The first concerns the saga of my Heavy Iron CNC project. Those of you following the project know it is taking me far, far longer to complete the project than my original optimistic estimate. I had supposed in the beginning that it might take me three months to build and four or five columns to present all the plans. Fourteen months later, I'm still not finished.

Last fall, I tried to expedite the project by taking a couple months off from covering it in this column. This helped, but it wasn't quite enough. After consultation with my editor, I've decided to stop covering Heavy Iron in this column altogether. Instead, I will get back to hands-on robotics projects while continuing work on Heavy Iron in the background. After Heavy Iron is finished (in a few months), I will write up a stand-alone article to give all the remaining details in one swoop. We felt this was better for all of you building the project than waiting for the dribs, drabs, and occasional flash floods that you've been getting.

The second item is the state of my carpets. Here at the Robot Ranch we have that pattern and shade of carpet designed to hide the stains and arrows of outrageous fortune that any family with small children knows all too well. Even so, my boys are resourceful. Shoshana and I spent half an hour not long ago debating the origin and composition of a particularly sticky stain in the dining room, and while we debated, we combed the goop out and scrubbed with a brush. Shoshana thought it might be a raisin, while I was of the opinion it must have once been a chocolate chip. It was one tough stain.

Now, I vacuum as often as I get the chance and I use a carpet sweeper after every meal and snack, but I still can't keep up. When things get too sticky and crunchy underfoot, we call in professionals. I figured there had to be a better way.

Robot Vacuum Cleaner

The only sensible answer was to build a robot for the job. Sure, lots of people have built robot vacuum cleaners, but I have never run across a robot capable of steam cleaning.

It would be folly to spend three hours a day for five months building a robot that would save me just 15 minutes of vacuuming a day. Saving the cost of professional carpet cleaning each month tips the balance, though.

The last time we hired someone to clean our carpets it cost $100.00, and we have a small house. It took our boys less than a week to grind enough grapes, raisins, rice, and Spaghetti-Os into the carpet to make it look as bad as before.

My robot wouldn't just save 15 minutes a day, it'd save $100.00 a week and give our kids a cleaner, healthier carpet to play on. And not just my kids, but kids all across the country. Not only should I build a steam cleaning robot, it became my moral responsibility as a parent and my patriotic duty as an American to build it. That's how I explained it to Shoshana, anyway.

It was simple: add a water tank and heating element to what would otherwise be an ordinary wet/dry vacuum system. There were still details to figure out — the robot drive and plumbing — but no showstoppers. Except for steam.

Making Steam

I dug out my engineering reference books and did some quick calculations on how much heat it would take to produce the flow of saturated steam needed. Not liking those results, I did longer calculations and re-acquainted myself with steam tables and terms such as enthalpy and specific heat that I learned 20 years ago in thermodynamics class.

To heat water from 72 degrees F to its boiling point takes 140 BTU/lb (about 326 kJ/kg in SI). To vaporize that water takes an additional 970.3 BTU/lb (2256.7 kJ/kg), so the total heat energy needed is about 1110 BTU/lb (2583 kJ/kg) to make saturated steam at one atmosphere.

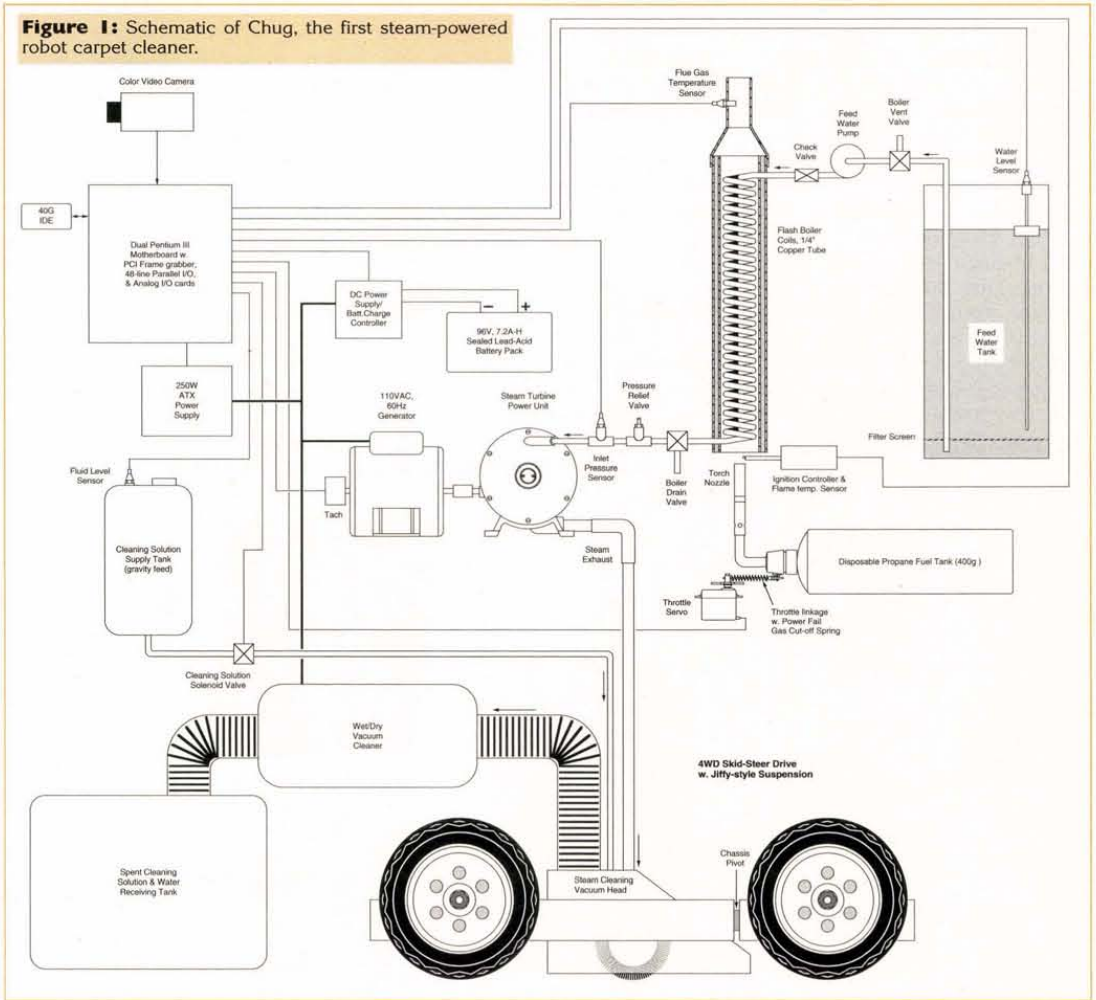
To convert half a gallon of water to steam in one hour would require 1,357 watts of heat. That's nearly two horsepower! For some perspective, 2HP is about the same as the peak horsepower of my wet/dry shopvac, and that draws 6A at 110VAC. Such a robot would require 170 lb of fully charged lead acid batteries — 16 W-hr/lb — just to run the vacuum cleaner and the steam generator. That's not counting the drive motors, the beater brushes, and the electronics. Call it 200 lb of batteries.

I remembered then just why it was we called that thermo class "thermogoddamics." It takes a lot of energy to make steam, and that's why you don't see battery-powered steam cleaners.

Getting Steamed

A robot with over 100 lb. of batteries breaks Nansel's Second and Third Laws of Hobby Robotics: never build a robot you can't easily pick

Figure 1: Schematic of Chug, the first steam-powered robot carpet cleaner.



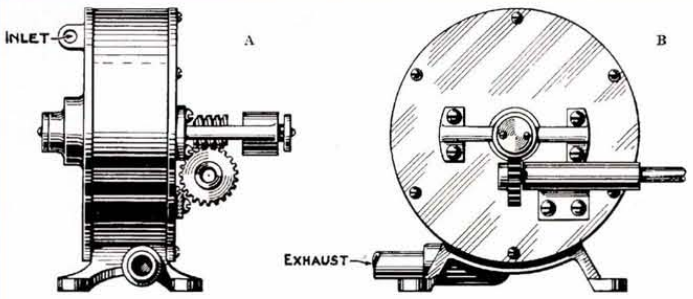


Figure 2: The steam turbine, front and side views. The worm reducer is clearly shown.

up; never build a robot uglier than it has to be. (The First Law is never build a robot you can't outrun.)

Even without a steam generator, the vacuuming robot would be too heavy. I was glumly thumbing through my engineering handbook when I was struck by how much attention is given to not only making steam, but to using steam to do work.

As in steam engines.

An idea gelled then, and I went in search of paper, pencil, and calculator. What if I made steam with fire? Any common fuel burned in air has a couple orders of magnitude higher energy density than any battery.

Lots of fuels — wax, alcohol, butane, methane, and propane — can burn cleanly with an open flame. Suppose I used an open-cycle steam engine to provide some of the electricity and all the steam? I could reduce the weight of the battery and increase the steam capacity. Thus, Chug was born.

I named the robot Chug because I first thought I'd use a piston-type steam engine. There are plenty of designs and kits for model steam engines in the 1/10HP to 2HP range, and I've even come across at least one steam-powered robot on the web; Dan Creagan's Puff1 (http://academic1.bellevue.edu/robots/puff.html).

What decided me against them was vibration. Single-cylinder steam engines produce lots of vibration, and multi-cylinder engines, though smoother, are just too complicated.

Turbo Power

A turbine, on the other hand, would be smooth, light, and efficient. Figure 1 gives a schematic outline of my design for a turbine-powered robot steam cleaner.

I remembered seeing a design for a small, simple steam turbine that hobbyists could build in an old book I once read. But that was 25 years ago in the library of Butte, MT, where I grew up. I didn't remember the author's name or even the title. *Model Building* or *Making Models* or something.

Turns out my local library has the book: *Model Making* by Raymond Francis Yates (I love librarians). The project was first published as *How To Build A Model Steam Turbine* by Arthur J. Weed in *Everyday Engineering Magazine* in February 1918. Yates — the magazine editor — later reprinted that article and others in *Model Making*. There, in Chapter XVI — "A Model Steam Turbine" — I found the design and construction notes for a 3" single-rotor steam turbine. It runs in a casing the size of a tuna can. It even includes a 20:1 worm reduction so the power take-off shaft turns at 1,750 instead of 30,000 RPM.

Figure 3: Photo of the turbine disassembled to show construction of the rotor. Two extra brass steam buckets in foreground.

Granted, it takes a small lathe and the skill to use it to make the turbine (facility with bronze casting would also be handy), but this beauty was just too cool to pass up. I've reproduced the plans from the book — with adaptations — in Figures 2 through 9. I have space for only a few construction details here, but *Model Making* has been reprinted by Lindsay Publications, so you can get all the nitty gritty details there (see sidebar).

The Hard Parts

The hard parts of building a turbine are: machining the blades; balancing the rotor for high-speed rotation; providing adequate bearing and lubrication.

The first problem is solved by pressing each of the 40 blades (or buckets) from soft brass sheet (Figure 9), then cutting and filing to shape (detail E of Figure 5). The buckets are soldered in slots around the rim of the rotor and a 3" diameter brass band goes around the whole assembly (detail F). If you have a dividing head and a milling machine, cutting the slots is easy; if you don't, use plain dividers to lay out the cut locations around the circumference of the rotor and an Armstrong Shaper (a.k.a., a hacksaw) to make the cuts.

The solder holds the buckets in place while turning their tops to the proper diameter on the lathe, when the 3" diameter brass band can almost be forced over them. The band is then heated to expand it enough to slip over the buckets, making a snug fit once the band cools. The whole rotor assembly is then turned true on the lathe, thus solving the balance problem.

The bearing and lubrication problem is solved with oil reservoirs and adjustable bearings (details L and J of Figure 7 and detail P of Figure 8). Two identical bushing sleeves (shown in perspective at L, and in section at J and P) are made from brass rod. They are machined for a close sliding fit in the smaller through-bores of the oil reservoirs, and their mounting screws allow one bushing to be tightened and its opposite loosened to adjust the axial (left and right) position and play of the rotor shaft. Note that the odd-looking loop at detail L is the oiling ring which sits in the slot cut into each sleeve. The oiling rings wick oil up from the reservoirs onto the shafts, and they must be installed after sliding the bushings in place, but before soldering brass washers (shown at K and P) to close up the oil reservoirs.

Detail A of Figure 2 shows the rotor shaft adjusted all the way to the right; there's a gap between the right bushing and the outboard bearing bracket, but there's no gap

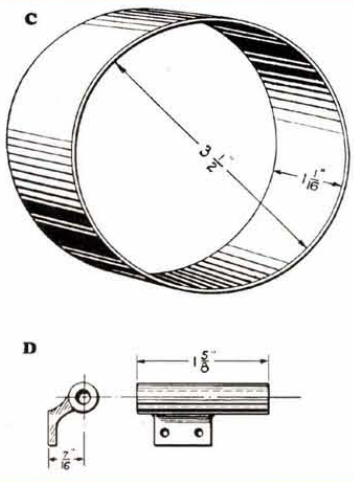
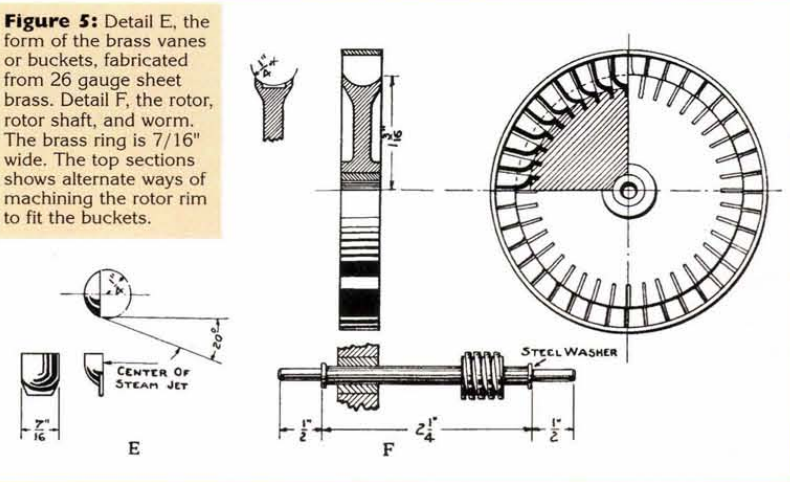


Figure 4: Detail C, the brass casing tube, 1/16" wall thickness. Note typo in book gives the width as 11/16" when it should read 1 - 1/16" as in the diagram. Detail D, the power take off shaft bearing bracket. This bracket is shown in position in detail B of Figure 2.

Figure 5: Detail E, the form of the brass vanes or buckets, fabricated from 26 gauge sheet brass. Detail F, the rotor, rotor shaft, and worm. The brass ring is 7/16" wide. The top sections shows alternate ways of machining the rotor rim to fit the buckets.



between the left bushing and the left head. This must sound complicated, but study the diagrams and it will make sense. Figure 3 is my photo of the finished steam turbine. It's shown disassembled after its first test run with compressed air at 60 PSI. After running the turbine, I know I've misnamed Chug; it should be called Whiner. It's not as loud as a jet engine (not quite), but it sure whines like one.

Blowing Off Steam

Did I say there were only three hard parts? The boiler is the fourth hard part. Compressed air is fine for testing, but to be useful, the turbine needs steam, lots of it. Boilers are the hardest part of any steam power system. First of all, there are so many kinds of boilers and even more kinds of valves: poppet valves, relief valves, needle valves, check valves, globe valves ...

Check the references to get the details. I chose a tube-type flash boiler with both a mechanical pressure relief valve and an electronic pressure sensor (Figure 1). The Pentium system controls the servo throttle with the pressure sensor closing the feedback loop. But if the software hangs, there's the mechanical pressure relief valve.

Safety tip: Always test boilers hydrostatically; if anything breaks, all you get is a water leak. If you test with air or steam, you get an explosion instead. I've tested my boiler to 120 PSI with water and a tire pump, and the mechanical pressure relief valve is set to 100 PSI. Should both the throttle loop and the mechanical valve fail, I've got a third failsafe not shown in Figure 1: a cut in one of the outer tubing coils sealed up with solder. If the temperature of the tube ever goes above 600 degrees F while under pressure, the solder joint will fail, thus relieving pressure and saving the day.

My boiler core was made by wrapping two layers of 1/4" copper tubing around 12" of a wooden dowel, or about 48 turns. The dowel was slightly under 1" in diameter. When completed, the coils spring open enough to remove the dowel. The first layer forms a right-hand helix, and the second layer a left-hand helix.

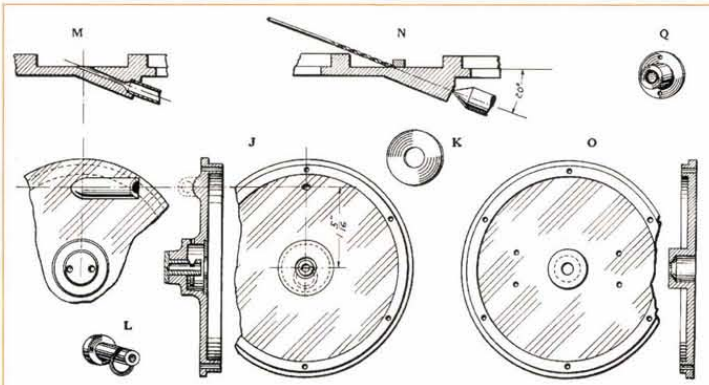


Figure 7: Detail J, "steam-side" casing head (see left side of detail A). Note that the book has a typo that gives the location of the steam nozzle hole as 15/16" above the center instead of 1 and 5/16" as shown in the diagram. Detail K, brass washer to be hard-soldered in place to close off steam-side oil reservoir cavity. Detail L, bearing bushing with oiler ring and slot. Detail M, final form of steam nozzle in casing head J. If you can't do castings, head J and steam nozzle lug M can be machined from separate pieces and hard-soldered together before drilling the nozzle. Detail N, method for drilling the steam nozzle. The rectangle shown at the drill tip is a small brass block soldered temporarily to the head to keep the drill from wandering off the center-punch dimple. Detail O, the "exhaust-side" head (see right side of detail A). Outboard bearing P mounts on this piece. Detail Q, the packing gland, machined from brass rod to fit in stuffing box bore of head O.

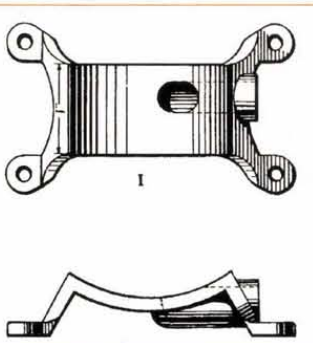


Figure 6: The base with steam exhaust tube molded in. This is the most difficult piece to duplicate without a casting. The alternative is to "unroll" the design flat onto 1/8" thick brass sheet stock. Cut, drill holes, and bend to shape. Cut and file to fit a 1/2" brass tube for the exhaust and hard-solder the tube and base assembly together. Align the exhaust tube cutout of the completed base assembly with a matching cutout in the casing tube. Solder the base assembly to the casing.

A Bigger Hammer

I had hoped to use a Weller Pyropen — a propane-powered soldering iron/torch — as the burner to fire Chug's boiler. The Pyropen has electronic ignition and easy adjustment, but it's limited to a maximum 60W output. As I've shown, this is just not enough heat to get Chug up to a full head of steam. Even three Pyropens in parallel aren't enough.

I needed a bigger heat source, and the cheapest one at hand was my 30-year-old Benz-O-Matic propane torch. I don't know exactly what its wattage rating is, but it surely does put out lots of heat.

The advantage of a full-size torch is you can pick up one of these torches and a bottle of propane for less than $15.00 at any hardware store. The disadvantage is you don't get electronic ignition or catalytic conversion at that price. Benz-O-matic does have their "Trigger-Start Torch" for about $30.00. It uses standard propane tanks, so one of these would drop right in place of my old torch. I figured I could live without electronic ignition for a while just to see if my old torch would fire Chug's flash boiler.

The first thing to do was to replace the torch's needle valve core with a quarter-turn valve core so a hobby servo could control the torch through its full range. The next thing was to bend the torch tube to the proper angle. The trick was to bend it without putting a crimp in the tube. This I accomplished by filling the tube with sand, clamping it in my vise, and bending it with a large pair of channel lock pliers while heating the bend with a second propane torch. (Hey, I needed a new torch anyway, right?)

Boy, does it ever work great with Chug's boiler. I've got so much steam I haven't had to turn the humidifier on in the house all winter. And the carpets? Well, the carpets will look better once I get the rest of Chug working.

Coming Clean?

Chug is by far the most complicated project I've ever covered in this column. I wish to thank Gene Elliot of Gig Harbor and Dan Creagan of Bellingham (both in the state of Washington) for the assistance they gave me in getting Chug to work right. Anything wrong with Chug's design is my own fault, not theirs. I don't have the tools or experience to tackle a project like this, but these two fine gentlemen have enough of both to build dozens of Chugs, and they helped me over the hump. It wouldn't have been possible without you, guys. Thanks.

Yes, you really can build it, but it's not for everyone. If you are at all wobbly with a metal file or hacksaw, or if you're not confident you know how to prevent it from causing housefires or third degree burns to you or others, stay away. But if you've got the tools and the know-how ...

In my other life — that thin slice not taken by fatherhood and this column — I am a science fiction author (yes, I've even been pub-

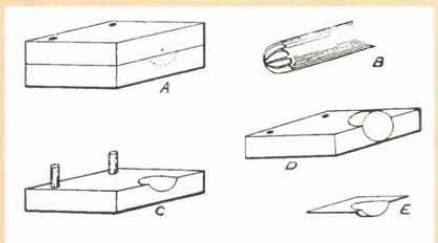


Figure 9: Method of forming buckets from 26 gauge brass sheet. Make the tool from two pieces of steel 3/8" x 1.5" and about 2" long. Clamp them together and drill two 1/4" holes to take guide pins as in Figure 9c. The opposite ends must then be squared up while the pieces are pinned and clamped. Make a center punch mark in one of the pieces 5/64" from the edge dividing the pieces as in Figure 9a. Drill a hole with a #24 bit to a depth of 3/8". With the two pieces firmly clamped, enlarge the hole with a 1/2" drill to the same depth, then make the final form with a 1/2" ball-end mill as shown in Figure 9b. Finally, a piece of 1/2" steel stock is turned to the same form as the end of the ball-end mill. Riveted to the upper plate, this forms the male "punch" (Figure 9d), and the lower plate forms the female "die" (Figure 9c). The guide pins maintain alignment. To use the tool, cut 1" square blanks of brass stock, sandwich the blank between the punch above the die below, and squeeze the sandwich in a vise. The pressed blank should now appear as in Figure 9e, ready to be trimmed.

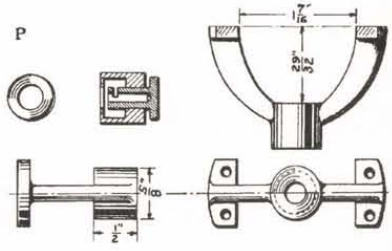


Figure 8: Detail P, outboard bearing, (see Figure 2 for placement). This piece is also tricky without a casting, but it can be made from solid stock at least 5/8" x 2" x 1.5". Rough out with a hacksaw, and file, file, file. Also shown in upper left is the brass washer used to enclose this oil reservoir and the situation of the brass bearing bushing.

lished, by paying markets). In a way, Chug is the fulfillment of a long-standing dream, to publish a serious work of hard science fiction, with equal emphasis on "science" and "fiction." Consider Chug a jest appropriate to the fourth month of the year. I hope you've enjoyed it (I know I did).

Coming Attractions

I've got some exciting new projects in the works for the next several months. We're getting back to *real* hands-on robot projects (unlike *Chug*), projects you can build in a weekend with tools you already have. Tired of the "two-wheels, two-motors, a battery, and a microcontroller" scene? Well, I plan to shake things up around here with new sensor and actuator projects.

On the sensor front, we'll look at nifty new color sensors from Taos, Inc. Their TSLx257 series of three-pin light sensors take the hard work out of sensing light levels by including a photodiode, transimpedance amplifier, and color filter in one package. Color filter? That's right, with the R-,G-, and B-versions you can sense RGB color (www.taosinc.com/products.htm#tslx257). If that isn't enough, I've got a cool robot to review that uses a true color vision system called CMUcam developed at Carnegie Mellon. One thing is certain, the world of amateur robotics will no longer be monochrome (www-2.cs.cmu.edu/~cmucam/). I'll also show you some simple ways to build your own linear actuators — and some good uses for them, too. See you next time! **NV**

If you have suggestions, questions, or comments about amateur robotics or other April Fools' topics, you can reach me at:
Robert Nansel
Box 228
Ambridge, PA 15003
E-Mail: **bnansel@nauticom.net**

Links

Basic steam engines:
http://jensensteamengines.com/commercial/c50.htm
A rough drawing:
http://www.pmresearchinc.com/piping001.html
A good kit:
http://www.tinypower.com/catalog.htm
Valved engines are more efficient, but oscillating engines are simpler to build. **Here's a very simple oscillating steam engine:** http://npmccabe.tripod.com/husky.htm
And here's a very weird and wonderful oscillator:
http://npmccabe.tripod.com/3sisters.htm
This one could probably be built by an average hobbyist. It has an advantage over a single cylinder engine in that it is self-starting. (Most single cylinder steamers have to be given a 'flip' to get going.)
Here's a good place to start with valved engines:
http://www.angelfire.com/mo/allsteamedup/
Has several good examples of valved engines (some from the "Tiny power" link above).
Animation of a double-acting valved engine:
www.geocities.com/Athens/Acropolis/6914/doppioe.htm
This helps you see how steam valves work in an engine similar to the Tiny Power engine. Steam valves are confusing until you build one. In this animation, the steam is entering from the left.

Books

Model Making, by Raymond Francis Yates Lindsay catalog #4325, $14.95. Get the book and you'll also find plans for a gyro-stabilized trolley, a radio-controlled submarine (1919!), several steam boats, a caterpillar tread tank, assorted steam boilers, and lots of steam engines, including 3-, 4-, and 6-cylinder radial steam engine designs for model airplanes. There's even a chapter on making your own lead-acid batteries. Compared to some of these projects, the steam turbine is a snap. As Lindsay notes, each topic in this book could be a book in itself. All I can say is, Wow.

Lindsay Publications
P.O. Box 538, Bradley, IL 60915-0538
tel: (815) 935-5353; www.lindsaybks.com
Lindsay has lots of books on steam engines and how to build them, large and small. If you want to build a steam engine, but don't have a metal lathe, there are even several books on how to build lathes, too.

Model Steam Turbines, Harrison Reference #TEE48.
The only new book on steam turbine models I'm aware of, this book gives designs and construction details for several types of steam turbine. Covers theory and practice in fine British style.
http://www.chronos.ltd.uk/acatalog/Chronos_Catalogue_Books_from_TEE_Publishing_56.html

Model Boilermaking, Pearce Reference #TEE44
A reprint of a practical handbook on design, construction, and treatment of small steam boilers. Lots of useful diagrams, very British.

MORE POWER
THE ATOM

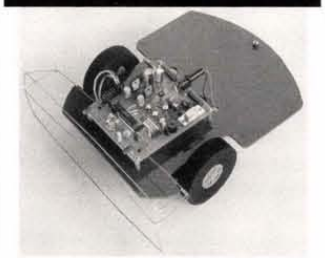
Setting a new standard in STAMPS
The New BASIC MICRO ATOM™, offers more in the same package you're already familiar with.With built-in features, like upgradable firmware, get more power for your projects now and into the future !

Software Features:	*Built in Hardware:*
• Graphical Debugging (ICD)	• Over 300 Bytes of RAM
• More Software Commands	• 256 Bytes of Data EEPROM
• 32 Bit Integer Math	• External & Internal Interrupts
• 32 Bit Floating Point Math	• 3 10 bit A/D Converters
• Easy to use code editor	• 2 Capture and Compare
• BS2p Compatible Syntax	• Internal Adjustable Vref
• Expanded BASIC library	• + / - External Vref
• Firmware upgradeable	• 3 Timers
• Unlimited Support	• 2 PWM
• Free Software Updates	• UARTS
• Plus much more!	• I2C, SPI

$59.95 Complete
Also available in Development Combos and OEM package

MORE FLEXABILITY
for PICmicro® MCU's
MBASIC

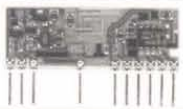
Ever wanted to learn how to program PICmicro® MCUs ? Now you can with easy to use BASIC. Our software is much simpler than C or Assembly. MBasic for PICmicro® MCUs creates a one click solution that allows you to experiment and test code changes on-the-fly! From beginner to professional bring your projects to life quicker and easier with MBasic for PICmicro® MCUs !
***New* - In Circuit Graphical Debugger built in!**
Priced from $99.95
Educational and Dealer pricing available with all products
PICmicro is a registered trademark of Microchip Inc.
BASIC MICRO INC.
Order online or call 1-734-425-1744
Basic Micro, 34391 Plymouth Rd., Livonia, MI 48150
See More online at http://www.basicmicro.com

QUICK and PAINLESS Programmable Robotics!

- COMES PRE-ASSEMBLED
- PRICED LOWER THAN A KIT
- Re-Programmable from your PC
- Co-Processor for IR proximity vision, Bumpers, Servo Controller, A/D, and MORE
- Drive servos have Dual Ball Bearings for longer life!
- Lots of free I/O, CPU power, and space for your modifications
- Genuine top of the line Basic Stamp 2p40® processor from Parallax Inc. Great tools, manuals, and books available for training or project development.

JUST ADD 6 AA BATTERIES AND GO!

Blue Bell Design Inc.
www.bluebelldesign.com

RF Data Modules



AM TRANSMITTER
- Small size: 17.78 x 11.43mm
- CMOS/TTL input
- No adjustable components
- Low Current. 4mA typical.
- 418MHz or 433.92MHz OOK
- Simple to integrate -simply add antenna, data and power
- Range up to 250ft.
- Wide supply range. 2-14Vdc
- SAW controlled - stability
- Also available in DIL package

AM-RT5 ..... $12.10

AM RECEIVER
- Compact size: 38.1 x 13.7mm
- On-board data recovery. CMOS
- Low current. 2.4mA typical
- 2kHz data rate. CMOS/TTL output
- 5Vdc operation
- On 418MHz or 433.92MHz (4xx)
- No adjustable components
- Patented Laser Trimmed component
- High stability
- Sensitivity: -105dBm
- Available also in 0.8mA version

AM-HRR3-4xx $10.95

FM TRANSCEIVER
- Only 23 x 33 x 11mm
- Up to 40k bps data rate
- 19200 baud with ASCII
- Up to 500ft. range
- 5v operation
- 0.25mW into 50
- 418 or 433MHz FM
- Fast 1ms enable
- Direct interface to 5V CMOS
- Auto TX/RX changeover

BIM-4xx-F $87.36

RS232 TRANSCEIVER MODULES

- 4,800 to 38,400 bps half duplex
- 3-wire RS232 interface
- µController with user EEPROM
- RS232 interface protected to ±15kV
- Data packetizing performed by user
- Auto TX/RX changeover
- 418 MHz and 433MHz versions
- Range up to 500ft. (0.25mW ver.)
- 0.25mW & 10mW versions
- Reset switch and status LED's
- 7.5-15V dc via DB9 connector, 20mA

BIM-4xx-RS232 .... $139.30

70 x 65 x 15mm

- Up to 19,200 bps half duplex
- 3 wire RS232 interface
- Range up to 500ft
- Transparent data packetizing
- Supports 8 or 9 bit protocols
- Self test function
- Reset Switch & Staus LED's
- 1/4 wave wire antenna on board
- Available in a Simplex Tx/Rx pair.(RTcomTX & RTcomRx)
- 7.5V-15Vdc operation

Transceiver.....	**RTcom-4xx..... $247.90**
Transmitter.....	**RTcomTx-4xx..... $ 87.15**
Receiver.....	**RTcomRx-4xx..... $105.52**

ABACOM TECHNOLOGIES
Free Catalog
Tel: (416)236-3858
Fax: (416)236-8866
www.abacom-tech.com
abacomtech@compuserve.com

Circle #52 on the Reader Service Card.

New Product News

Continued from page 50

mounted over the prototyping area. Custom circuitry can be built on the breadboard using jumper wires. Hence, no soldering is required. In addition, all CPU lines are available at female header connectors. Thus, jumper wires can also be used to connect to the processor.

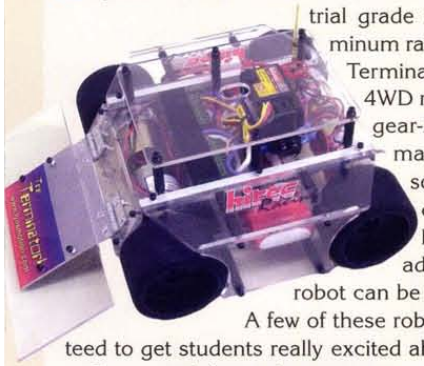
The board measures 4.75 by 6.75 inches. Board features include: prototyping space with optional solderless breadboard, female header connectors and solder pads for connections to the processor, eight LEDs, eight-position DIP switch, RS-232 serial port with DB-09 female connector, DS1233 EconoReset for reset generation, and one-amp voltage regulator.

For more information, contact:

ALLEN SYSTEMS
2346 Brandon RD., DEPT. NV
Columbus, OH 43221
614-488-7122
CONTACT: **JOHN ALLEN**
EMAIL: **allensys@aol.com**
WEB: **www.allen-systems.com**

Terminator 3kg Class Sumo Robot

The Terminator is one of six 3kg Class Sumo Robots that Lynxmotion has scheduled for release. It is constructed from industrial grade impact-resistant acrylic and aluminum rails to form a unibody chassis. The Terminator (part #SR3-KT $163.00) is a 4WD robot that features powerful 6VDC gear-head motors that are custom made for Lynxmotion. Borrowing some components from the RC car industry, this robot can easily be remote controlled. With the addition of your favorite MCU, the robot can be autonomous with little effort.



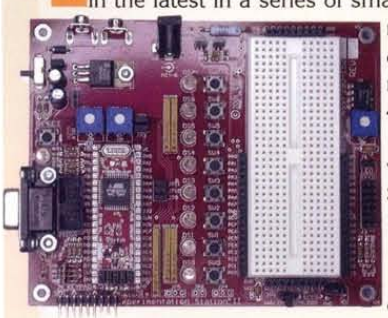
A few of these robots and a five foot ring is guaranteed to get students really excited about technology and robotics.

For more information, contact:

Lynxmotion, Inc.
P.O. Box 818, dept. nv
Pekin, IL 61555-0818
309-382-1816 (Sales) Fax: 309-382-1254
EMAIL: **sales@lynxmotion.com**
WEB: **www.lynxmotion.com**

Self-Contained Development System for Atmel AVR Microprocessors!

Embedsys.com introduces the ESI AVR® Sprint 8535/Mega module in the latest in a series of small, self-contained devices that implements a complete microprocessor development system, on a small module that plugs into a standard 40-pin IC socket.



When the module is combined with a simple cable, PC, and the Sprint Basic compiler, a fast and powerful AVR development system is realized for a very modest price.

The module features up to 32K of in-circuit programmable flash memory for your program, up to 2K of SRAM, EEPROM, and a wealth of on-board I/O peripherals including an RS-232 compatible hardware-based UART in addition to an eight-channel 10-bit A/D converter.

The module also contains two crystal timebases (for the processor and real-time clock), a low power voltage regulator, and circuitry to turn off the module's peripherals for ultra low power operation.

The module is available in three different types and can be purchased separately or as part of a development system.

The development system enables a quick start for your design by providing everything you need to develop your application in a single package — just add the PC. Development systems also include a 'C' compiler and an assembler.

The starter system includes the programming cable, power supply, and the full version of the Sprint BASIC compiler, in addition to full documentation on CD.

The full Experimenter's Station II, allows you to quickly connect a keyboard, LCD display, and provides a prototyping area, in addition to lights, switches analog voltage sources, and a 200mA regulated 5V supply. A printed Sprint Basic manual is also included with the Experimentation Station II.

For more information, contact:

ESI
11931 Hwy 65 N.E., DEPT. NV
Blaine, MN 55434
763-767-2748
Email: **webmaster@embedsys.com**
Web: **www.embedsys.com**

iSun™

The iSun™ is the most complete solar charger for small electronics on the market. It comes with plugging accessories that will enable you to run over 90% of all small electronics.

The traveler can use it to run cellphones, PDA, portable computer, etc. Or use it to run a GPS, FRS radio, two-way radio, handheld video game, digital camera, portable MP3, minidisc, or CD player

The iSun can run small electronics requiring less than two watts and can help run any small electronics over two watts by connecting multiple iSun units together. Daisy-chaining the unit with another one can double the power outage.

The iSun unit can be used in all sunny conditions. The brightest conditions will yield better charging output. The iSun can charge rechargeable batteries within two to eight hours depending on the amount of sun exposure and on the type of rechargeable battery, which is usually between 500mA and 1500mA.

The iSun™ family will grow very soon with added accessories to help give your customers new choices in portable power. The first such accessory is code-named "BattPak."

The BattPak will slide under the iSun into its docking bay permitting the portable power user complete power independence, day or night, wherever they may be. The BattPak will act as a 6V/12V power source, and a power charger for portable electronics which feature their own internal rechargeable batteries. The iSun can be used with anything that can be used in a car.

The iSun is approximately $80.00 US.

For more information, contact:

QUALITY KITS
49 McMichael St., Dept. NV
Kingston, Ontario K7M 1M8
CANADA
Order Line **1-888-GO 4 KITS**
613-544-6333
WEB: **www.qkits.com**

High Tech Video system w Audio

Includes TWO B/W Cameras w sound & I.R. (night vision) ONE 5.5" B/W Monitor with Built-In adjustable Switching(from 2 to 20 seconds)& two 60 ft. pre-wired cables. Everything you need to set up a high tech video monitoring system at home, office,restaraunt warehouse or use it as a baby monitor. Easily hooks into VCR for Video Recording also

item # Dual View

Fantastic Price!

$119.00 ea

($109.00 ea. qty 4)

view extensive details@ web site

2GHz RF Field Strength Analyzer

ONLY $1699

Best Price!

- Frequency Range: 100KHz to 2,060MHz
- Narrow Band FM (NFM), Wide Band FM (WFM), AM and Single Side Band (SSB) Modulated Signals May Be Measured
- PLL Tuning System for Precise Frequency Measurement and Tuning
- LED Backlight LCD (192x192 dots)
- Built-In Frequency Counter
- Hand-Held and Battery Operated
- All Functions are Menu Selected
- RS232C for PC Interface and Printer

#3201

See the web site for details

Removable Hard Drive Rack

For IDE/Ultra DMA Hard Drives

We Sold Over 18,000 in 2000!

ONLY $14.95 any qty.

This product can be used with any 3-1/2 IDE hard drive up to 1" high. It includes an electronic keylock for safe removal and insertion. Made of ABS 707 fireproof plastic. Use this product to protect sensitive hard drive data, take your hard drive between work and home or even set up different users with their own hard drives that they physically insert every time they use a PC. Other models available from C.S.I. include RH10 series and RH20 series, which are interchangeable within the same interface design (IDE or SCSI).

RH-10C-IDE

Other Models are Available. *See www.web-tronics.com under "hard drive and accessories" for more details and pictures.*

Dual Output Bench Power Supply

with four 3 1/2 digit LCD Displays

Output: 0-30VDC x 2 @ 2 AMPS
Source Effect: <0.02%+1mV
Load Effect: <0.01%+5mV
Ripple & Noise: <1mVrms
Dimensions: 365 x 265 x 164 mm
Input Voltage: 110VAX+/- 10%

CSI3002D-2.....$159.00
(qty 5+...$149.00) *Details at www.web-tronics.com*

Auto-Temp Solder Station with Ceramic Element

ONLY $39

- With Ceramic Heating Element for More Accurate Temp Adjustment
- 3 Conductor Grounded Power Cord
- 250°C-480°C (470°F-900°F)
- Fast Heating Feature

SR-976

Extra Tip Options Available. See Web!

CTRL - D to bookmark this site

www.web-tronics.com

Don't forget the dash

- Easy to Navigate
- Includes a Search Engine That Really Works
- New Items Added Constantly

Circuit Specialists Inc.

In Business Since 1971

For More Info See www.web-tronics.com

Mini CCDs (B/W & Color)

Sensational NEW Design for Small Observation Cameras. *Smaller and Better!*

- ***Ultra Miniature Design***
- ***Black & White Versions Only 25mm x 25mm***
- ***Color Versions Only 32mm x 32mm***
- ***Available in Standard Lens or Pinhole Lens***
- ***All Include Pre-Wired Cable Harness for Video & Power***
- ***12V Regulated Power Supply Required (120mA typical power consumption)***
- ***0.1 LUX Rating (B/W), 1 LUX (color)***
- ***CCD Area Image Sensor for Long Camera LIfe***
- ***Back Light Compensation Circuit***
- ***Built-In Electronic Auto Iris Lens***

Detailed Specs on the Web

VMCW-H11A 32mmx32mmx30mm, Color CCD with standard lens, pre-wired cabling for video/audio, 12V DC Power $109.00 / $99.00 5 or more

VMCW-H12A 32mmx32mmx19mm, Color CCD with pinhole lens, pre-wired cabling for video/audio, 12V DC Power Input $109.00 / $99.00 5 or more

VMPS-718A 25mmx25mmx30mm, B/W CCD with standard lens, pre-wired cabling for video/audio, 12V DC Power Input $49.00 / $45.00 5 or more

VMPS-250A 25mmx25mmx15mm, B/W CCD with pinhole lens, pre-wired cabling for video/audio, 12V DC Power Input $49.00 / $45.00 5 or more

CCD B&W Board Cameras

- ***ASIC CCD Area Image Sensor***
- ***Extremely Low Power Consumption***
- ***0.5 Lux Min Illumination***
- ***Built-In Electronic Auto Iris for Auto Light Compensation***

Detailed Specs on the Web

Detailed Specs on the Web

VM1030PA-B 30mmx30mmx25mm, Pinhole lens, 12V $39.00 any qty.

VM1030A 30mmx30mmx26mm, Standard lens, 12V $39.00 any qty.

VM1035A 42mmx42mmx25mm, Standard lens, 12V with back light compensation $49.00 any qty.

VMCB21 44mmx38.5mmx28mm, with 6 infra-red LEDs, 12V $49.00 any qty.

VM1036A 32mmx32mmx25mm, Standard lens 12V, reverse mirror image feature $49.00 any qty.

B&W, Color & Powerful Night Vision Model Bullet CCD Cameras

- ***Smart Rugged Metal Housing***
- ***Extrememly Low Power Consumption***
- ***12 Volt***
- ***CCD Area Image Sensor for Long Camera Life***
- ***Built-In Electronic Auto Iris for Auto Light Compensation***
- ***No Blooming, No Burning***
- ***0.1 Min Lux Illumination (B&W), 1 Lux Min Lux Illumination (color)***

Detailed Specs on the Web

VMBLT1020 B&W, 21mm(D)x55mm(L) $49.00 any qty.

VMBLT1020W B&W Weatherproof, 21mm(D)x58.5mm(L) $69.00 any qty.

VMBLTJC19BW COLOR! Weatherproof, 17mm(D)x88mm(L) $109.00 any qty.

WDB-5007S Powerful **night vision** camera(56 IR LEDS) $159.00 ($139.00/ 5+)

COLOR CCD Mini Board Cameras

- ***Low Power Consumption***
- ***1 Lux Illumination***
- ***Built-In Electronic Auto Iris for Auto Light Compensation***
- ***Internal Synchronization***
- ***12Volts***
- ***400 TV Lines***

Detailed Specs on the Web

VM3010PA 33mmx33mmx18mm, Pinhole lens with audio $99.00 any qty.

VM3010-A 33mmx33mmx32mm, Standard lens with audio $99.00 any qty.

new!

Bench Digital Multimeter w RS232C

$99.00 !

Item# CSI9803R

*Digital & Analog Display, 3999 counts & 42 segment bar graph.
*Autorange & Manualrange
*DATA HOLD, Min/Max Relative Measurement
*Storage Data DISPLAY/RECALL
*True RMS f AC voltage & current
*Back Light
*ADP Measurement:400mV+/-3%
*Continuity & Diode test
*Power Source: AC or DC

See details @ web site

O'Scope Offer

30MHz! ONLY $299!

ONLY $299

- *Dual Channel*
- *Dual Trace*
- *Vert Trigger*
- *1 Year C.S.I. Warranty!*

#OSC-1030

Includes 1 oscilloscope probe

Manufactured for CSI by a leading O.E.M. manufacturer. See our website for detailed specifications!

new!

DC to AC Power Inverters !

150 watt up to 3000 watt models!

Check Our Low Prices!

150w modified sine wave:$29.95(G-12-015B)
300w modified sine wave:$39.95 (G-12-030)
150w pure sine wave:$69.00(G-12-150S)
300w pure sine wave:$109.00(G-12-300S)
800w modified sine wave:$139.00(G-12-800)
1000w modified sine wave:$179.00(G-12-100)
3000w modified sine wave(phase corrected), (G-12-300).....$489.00

See Our web site for DETAILED Specs.!

G-12-030 300W

Digital Read Out 3Amp Bench Power Supplies

Available in 0-30 volt & 0-50 volt versions

AS LOW AS $85

High stability digital read-out bench power supplies featuring constant voltage and current outputs. Short-circuit protection and current limiting protection is provided. Highly accurate LED accuracy and stable line regulation make the 3000 series the perfect choice for lab and educational use.

Line Regulation: $2x10^{-4}$ +1ma
LED Accuracy: Voltage ±1% +2 digits
Current ±1.5% +2 digits
Wave Line Noise: ≤1mvrms
Dimensions: 291mm x 158mm x 136mm

New! Lower Prices

CSI3003: 0-30v/0-3amp 1-4 / $89.00 5 + / $85.00

CSI5003: 0-50v/0-3amps 1-4 / $109.00 5+ / $99.00

Bookmark our WEB Site! Many more Power Supplies are Available. Look Under Test Equipment

Our Most Sophisticated DMM

We Sold Over 800 Last Year!

with RS-232 Interface & Software, 3-3/4 Digit, 4000 Count, Auto-Ranging with Analog Bargraph

NOW ONLY $149 *Reg. $169*

- True RMS Mode
- 10MHz Frequency Counter
- Time Mode with Alarm, Clock, and Stop Watch
- Dual Display
- 10 Location Memory
- Min, Max, Avg and Relative Mode
- Decibel Measurement
- Cap and Ind. Measurement
- Temperature Mode (C/F)
- K Type Temperature Probe Included
- Pulse Signal for Logic & Audible Test
- Continuity/Diode Test
- Logic Test
- Auto Power OFF/"Keep ON" Mode
- Fused 20A Input with Warning Beeper
- Back Light
- Data Hold/Run Mode
- Safety Design UL1244 & VDE-0411
- Protective Holster
- Silicon Test Leads

More Details on our Web Site

PROTEK 506

$129.00 ea. qty 10

Circle #145 on the Reader Service Card.

Selected Titles For The Electronic Hobbyist and Technician —

The NV Hobbyist Bookstore

Robotics

The Robot Builder's Bonanza
by Gordon McComb

A major revision of the bestselling "bible" of amateur robotics building — packed with the latest in servo motor technology, microcontrolled robots, remote control, Lego Mindstorms Kits, and other commercial kits. ***$24.95***

Microcontrollers

Handbook Of Microcontrollers
by Myke Predko

This reference is the first guide to cover all the most common types of microcontrollers. With its from-the-bottom-up approach, this book/CD-ROM package gives you all the information you need to simplify the job of selecting the right microcontroller and writing an application for it. ***$54.95***

Programming & Customizing the 8051 Microcontroller
by Myke Predko

Programming and Customizing the 8051 Microcontroller puts you in control of the 8051's architecture and instruction set — and even supplies a baker's dozen of ready-to-build example applications, programs, and circuits. Best of all, the included CD-ROM supplies source code for the book's experiments and applications. ***$39.95***

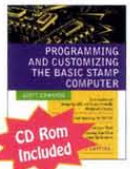
Programming & Customizing the HC11 Microcontroller
by Tom Fox

Applications bazaar for the 68HC11 microcontroller. Squeeze every last drop of power out of Motorola's wildly popular family of 68HC11 true 8-bit single chip computers! From basics to complete applications. ***$39.95***

Programming & Customizing PICmicro Microcontrollers *2nd Edition*
by Myke Predko

This book is a fully updated and revised compendium of PIC programming information. Comprehensive coverage of the PICMicro's hardware architecture and software schemes complement the host of experiments and projects making this a true, "learn as you go" tutorial. ***$49.95***

Programming & Customizing the BASIC Stamp Microcontroller
by Scott Edwards



This edition moves you briskly from electronic foundations through BASIC Stamp "Boot Camps" and an intelligent traffic signal simulation to build a robotic bug with whisker sensors, a time/temperature display, and a data-logging thermometer. ***$39.95***

PIC Microcontroller Project Book
by John Iovine

This project-oriented guide gives you 12 complete projects, including: using transistors to control DC and AC motors, DTMF phone number logger and distinct ring detector and router ... home automation using X-10 communications ... digital oscilloscope ... simulations of fuzzy logic and neural networks ... and many other applications. ***$29.95***

The Nuts & Volts of BASIC Stamps Vol. 1 & 2

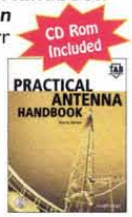
In 1995, Scott Edwards began authoring a column on BASIC Stamp projects in *Nuts & Volts Magazine*. The column quickly became a favorite of *Nuts & Volts* readers and continues today with Jon Williams at the helm. *The Nuts and Volts of BASIC Stamps* is a collection of about 75 of these columns.

Radio & RF

Secrets of RF Circuit Design *3rd Edition*
by Joe Carr

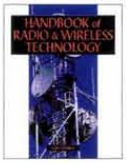
This revised and updated guide gives you the best ways to design, build, and test today's radio frequency circuits. It's filled with projects and experiments that make it easy to apply RF principles to real-life applications. ***$39.95***

Practical Antenna Handbook *4th Edition*
by Joe Carr



The most popular book on antennas ever written. This edition blends "the theoretical concepts that engineers and others need to design practical antennas, and the hard-learned practical lessons derived from actually building and using antennas." ***$49.95***

Handbook of Radio & Wireless Technology
by Stan Gibilisco



Containing more than 1,000 concise articles, this one-stop source of user-friendly insight provides blanket coverage of one of the fastest-growing areas in communications from antennas and transmission lines, to analog and digital modulation techniques, to satellite, space, and laser communications. ***$44.95***

Beginners Handbook of Amateur Radio *4th Edition*
by Clay Laster

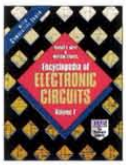
The revised edition of the most trusted guide in ham radio is here. This edition delivers all the guidance you need — from radio and electronics fundamentals needed to set up a transmitter to the newest equipment to revisions to the FCC rules and tests. ***$34.95***

Electronics

Practical Electronics For Inventors
by Paul Scherz

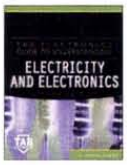
This experiment-oriented guide is loaded with over 750 hand-drawn images that support author Paul Scherz's crystal-clear, fully detailed instructions, showing you how to turn theoretical ideas into real-life gadgets. ***$39.95***

Encyclopedia of Electronic Circuits Vol. 7
by Rudy Graff



Designed for quick reference and on-the-job use, the *Encyclopedia of Electronic Circuits*, Volume 7, puts over 1,000 state-of-the-art electronic and integrated circuit designs at your fingertips. This collection includes the latest designs from industry giants such as Advanced Micro Devices, Motorola, Teledyne, GE, and others, as well as your favorite publications, including *Nuts & Volts*! ***$39.95***

Guide To Understanding Electricity & Electronics
by Randy Slone



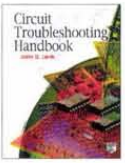
For the true beginner, there's no better introduction to electricity and electronics. You'll also find 25 complete projects that enhance your electricity/electronics mastery, including 15 new to this edition, and appendices packed with commonly used equations, symbols, and supply sources. ***$24.95***

Digital Electronics Guidebook: With Projects
by Myke Predko

Perfect for electronics hobbyists and students — even complete beginners — who want to understand digital logic and build their own low-cost logic circuits. Featuring more than 20 projects with step-by-step directions for designing, constructing, and interfacing easy-to-do TTL (Transistor-Transistor Logic) circuits. ***$34.95***

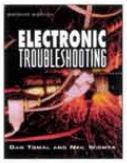
Troubleshooting

Circuit Troubleshooting Handbook
by John D. Lenk



Heavily illustrated with diagrams and schematics, it uses a standard, easy-to-follow format to help readers understand and troubleshoot a wide range of circuit types, and provides proven circuit testing techniques for all levels of instrumentation. ***$39.95***

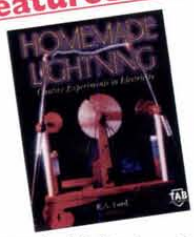
Electronic Troubleshooting *2nd Edition*
by Dan Tomal and Neil Widmer



This updated tool gives all the fundamentals needed to do successful servicing and repair work, blending traditional theory with the very latest insight into modern electronics technology. Time-saving tables, charts, and illustrations pinpoint equipment problems in a snap. Numerous reference guides, rules of thumb, and tricks of the trade all combine to assist in troubleshooting the full spectrum of devices and products more easily than ever before. ***$39.95***

High Voltage

This Month's Featured Title



Homemade Lightning: Creative Experiments in Electricity
by R.A. Ford

Enter the wide-open frontier of high-voltage electrostatics with this fascinating, experiment-filled guide. You'll discover how to make your own equipment, how electricity is used in healing, and the workings of many experiments in high potential physics! ***$24.95***

Call 1-800-783-4624 today! or order online at www.nutsvolts.com WE ACCEPT VISA, MASTERCARD, AMERICAN EXPRESS

Prices do not include shipping and may be subject to change. Ask about our 10% subscriber discount on selected titles.

For Starters...

Start programming BASIC Stamps with our enhanced Starter kits.

#27203 - $159

If you're new to the BASIC Stamp, try the BASIC Stamp 2 Starter Kit. We've published a wealth of applications for education, robotics, process control and interfacing to high voltage. A selection of development boards lets you achieve the project quickly often without custom PCB design. The BASIC Stamp 2 Starter Kit includes the BS2-IC module, programming board, BASIC Stamp Manual V. 2.0, CD-ROM, serial cable and a component pack.

- BASIC Stamp 2 Starter Kit with Board of Education (#27203 - $159)

To get more information and see additional BASIC Stamp Starter Kits visit our websit at www.parallaxinc.com.

Purchase a BASIC Stamp 2/2sx/2p24 Starter Kit between now and April 30, 2002, get a 9V 300 mA power supply free!

#27235 - $199

Want to get started with the ultimate BASIC Stamp? The BS2p24 module has an ample and accessible 16K EEPROM for datalogging and program storage. Interfacing with devices like GPS units, I²C sensors, and LCDs is easy with the BS2p. The BS2p Professional Starter Kit includes the BS2p24 module, the BS2p Demo Board, BASIC Stamp manual, CD-ROM, serial cable and component pack. With the component pack and documentation you will be able to build a time and temperature datalogger.

- BS2p Professional Starter Kit (#27235 - $199)

Order any BASIC Stamp 2/2sx/2p24 Starter Kit through the end of April 2002 and receive a free power supply (an $8.00 value)!

Order online www.parallaxinc.com

PARALLAX inc

or call toll-free 888-512-1024

BASIC Stamp and the Parallax logo are registered trademarks of Parallax, Inc.

Circle 154 on Reader Service Card.

NUTS & VOLTS MAGAZINE
430 PRINCELAND COURT
CORONA, CA 92879-1300